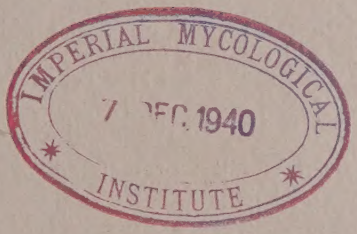
THE

Journal of the

AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE

PUBLISHED QUARTERLY



SUBSCRIPTION PRICE:

10/6 per Volume of Four Numbers, post free; Single Copies, 3/-.

Issued Free to Members of the Australian Institute of Agricultural Science.

Registered at the G.P.O., Sydney, for transmission by post as a periodical.

VOL. 6, No. 3. SEPTEMBER, 1940.

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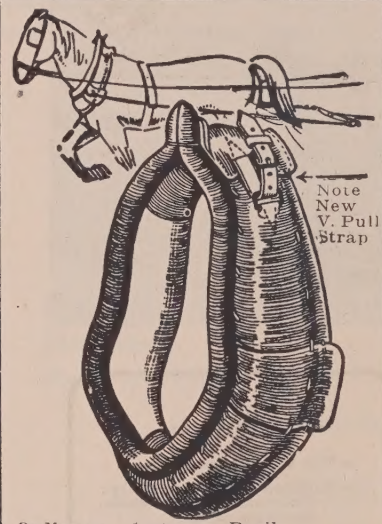

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Registered at the G.P.O., Sydney, for transmission by post as a periodical.

Editor :
H. J. HYNES, D.Sc.Agr., M.Sc.
Address : Box 3819T, G.P.O., Sydney, N.S.W.

Business Manager :
N. S. NOBLE, D.Sc.Agr., M.Sc., D.I.C.
Address : Box 3819T, G.P.O., Sydney, N.S.W.

VOL. 6, No. 3 SEPTEMBER, 1940

Agriculture and the War

By A. E. V. RICHARDSON, C.M.G., M.A., D.Sc.,

Deputy Chief Executive Officer, Council for Scientific and Industrial Research.

Australian agriculture can render its most effective contribution to war-time economy by the mobilising of the farm front to secure the following objectives:

1. The effective stimulation of those primary industries, the output of which is essential to the Empire in its war effort.
2. The expansion of certain primary industries to provide, as far as is economically possible, for the production in Australia of commodities which hitherto have been imported wholly or in part.
3. The increase in farm efficiency by the application of the best technical methods so that primary industry may be in a sound position to counteract the effects of rising costs of production, shortage of labour and competition for narrowing markets.

Stimulation of Primary Industry to Supply Empire Needs.

At the outbreak of war the entire woolclip was purchased by the United Kingdom for the duration of the war and one year thereafter, together with the export surplus of meat, dairy produce, eggs, sugar and dried fruits for the season 1939-40. During recent months, rapid changes have taken place in the European situation. The enemy occupation of the western European coastline from Norway to the Spanish border has greatly accentuated the difficulties confronting Empire shipping in the task of transporting raw materials and foodstuffs to Britain. Extended negotiations have taken place between the British and Commonwealth Governments regarding the primary products which the former Government considers

essential to the prosecution of its war effort. In a statement to the House of Representatives on August 6th, 1940, the Deputy Prime Minister (The Hon. A. Cameron) indicated the directions in which increased production by Australia would be of assistance to Britain during the war.

At a meeting of the Australian Agricultural Council in Sydney on August 12th, consideration was given to the problems of war-time policy in the light of United Kingdom requirements as disclosed by the Deputy Prime Minister. The Council affirmed that, subject always to shipping space, the position broadly was as follows:

1. There is a definite demand from the United Kingdom for an immediate increase in the production of eggs, butter, dried milk, condensed milk, cheese, flax and probably for pig meat.
2. There is no sign of any increased demand for wool, dried fruits, barley, rice, lard, tallow or sugar. Normal production of these would appear to be adequate. The United Kingdom Government's desires in regard to Australian supplies of beef, mutton and lamb have not been finally settled.
3. Wine, canned fruits and fresh fruits have so low an order of priority that their export in anything approaching normal quantities must remain a matter of doubt.
4. The production of tobacco, cotton, vegetable, pasture and other seeds and certain fibres must be stimulated.
5. Since a considerable proportion of the wheat crop remained unsold, it was desirable to encourage the diversification of the wheat industry by associating sheep with wheat; and by the expansion of the poultry and pig industries in the wheat belt.

This brief summary provides the basis of a policy for adjusting and organising Australian production to the war-time needs of Britain.

The demands on shipping space have necessitated the adoption of a system of priority under which foodstuffs most urgently needed receive first preference, whilst those least necessary for the war effort may be excluded. It will be noted that dairy products have been placed high on the priority list and the prospects for increased exports from Australia of cheese, dried whole milk, dried skim milk and condensed milk are particularly favourable. Seasonal conditions will, of course, exert a great influence on the success of any plans for rapid increase in production of dairy products.

The Australian Agricultural Council considered that the long-term market prospects justified the adoption of an energetic policy of intensive production in the dairy industry in all States.

The demand for eggs was also such as to justify greatly increased production throughout the Commonwealth. Increased production, however, was dependent largely on the availability of wheat for feeding to poultry at a reasonable price, and also on the availability of supplies of meat meal or other animal protein foodstuffs. It is understood that the Ministry of Food would be prepared to take large quantities of eggs if they were available in the form of dried or pulped eggs.

The position as regards fibre flax is fairly generally known. The area under crop has already been expanded in Australia from 2,000 to 21,000 acres to provide for domestic requirements and a substantial surplus for export to Britain.

The wool clip has been purchased for the duration of the war and one year thereafter, but with reduced consumption arising from the occupation of European countries, the wool industry may have to face serious post-war problems, and there would not be justification for increased production. It would appear wise policy to improve existing wool standards and wool-growing efficiency rather than to stimulate wool production.

In regard to meat, the position is somewhat uncertain owing to the collapse of France which has resulted in the diversion of large quantities of meat from that country to the United Kingdom. The present indications are not favourable for an expanding rate of purchase of Australian beef, mutton and lamb, but the prospects for frozen baconer carcases are better. The Australian Agricultural Council indicated that any appreciable expansion in pig production on dairy farms would be governed to a large extent by the greater use of grain in conjunction with the available skim milk supplies. The increased demand for dried skim milk may limit the potential increase of pig production on dairy farms. In other than dairying districts, a limiting factor is the amount of meat meal available. The increase in pig production would also be governed by the supply of breeding sows available and the effect of an active policy of increase in this direction would become apparent in 12 to 15 months. In all States a vigorous drive is in progress to increase the quantity and improve the quality of pig products.

The prospects of a demand for fresh fruits, canned fruits and wine are far from encouraging; their bulk in relation to their food value severely prejudices their claims on shipping space.

Tobacco, cotton, vegetable and pasture seeds, linseed, and other oil seeds are not at present produced in quantities sufficient to meet local requirements and their increased production, where economically feasible, should be stimulated; ways and means of ensuring this are discussed below.

Production of Commodities Hitherto Imported.

There is an urgent need to develop or expand, where economically feasible, the production of commodities which, in the past, have been imported wholly or in part.

The case of flax has already been mentioned. Though flax has been grown in Australia for upwards of forty years, its production (except in the last war) has fallen far below Australian requirements. During recent years the prospects of establishing the flax industry on a sound basis have greatly improved owing to the development of improved fibre varieties and of improved methods of processing the fibre. The production of flax may be undertaken in Australia with some confidence where soil and climatic conditions are favorable to its growth and where modern processing mills for treating the flax straw are likely to be available within reasonable distance of production centres.

The area under flax has expanded from 2,000 acres to 21,000 acres during the past year, and processing plants for the treatment of the straw are in course of erection.

The Australian demand for raw cotton has doubled since the outbreak of war, due to the requirements of the defence services for this essential

material. The Commonwealth Government has agreed to a bounty for a period of five years to encourage production, and the Queensland Government on its part has undertaken to embark on a programme of development which aims at stimulating cotton production under conditions of supplementary irrigation facilities and the improvement of the average yield per acre. A substantial increase in the research and extension services of the Queensland Department of Agriculture has been planned to encourage the production of cotton.

The possibilities of ramie as a source of fibre are being tested by a private company.

A substantial increase in the production of tobacco would appear to be possible. In July, 1940, a conference between technical officers, growers and manufacturers led to an understanding regarding acreage to be aimed at during the coming season and the extent of the purchase of leaf of certain grades. It is possible that an increase of 7,500 acres involving an increased production of approximately 3 to 4 million pounds of tobacco might be obtained if the immediate difficulties due to finance, labour and water supply can be overcome.

With the cutting off of supplies from Europe, there are opportunities for the local production of vegetable seeds and possibly for some export to the United Kingdom. For some time past, the New South Wales Department of Agriculture has been encouraging the production of certain classes of vegetable seeds. Opportunities exist also for the local production of such pasture seeds as perennial ryegrass, cocksfoot, white and other species of clover.

The annual import of linseed for oil extraction approximates £500,000 per annum. Until recently, the development of linseed growing was unattractive, but investigations by the N.S.W. Department of Agriculture on the Murrumbidgee irrigation areas with appropriate seed varieties have been distinctly promising. With the increased prices for imported seed, the prospects for the local production of linseed are attractive. Other oil-bearing crops which have possibilities are soybeans, rape, sunflowers, and the castor oil plant which is a roadside weed in the North Coast districts of New South Wales.

Increase in Farm Efficiency.

Any plan for the improvement of agriculture should include provision for production at low cost. The application of the best technical methods to the various branches of primary industry is an effective means of achieving this objective. Among the general measures which would improve farm efficiency are the elimination of leakages in production due to diseases in crops and livestock, the efficient and economical use of fertilisers, the improvement of pastures particularly in the better rainfall areas, the conservation of grass and fodder crops to even out production, the growth of varieties of crop for which the land is best adapted, and increased use of labour-saving machinery.

In addition, there are the innumerable technical details regarding the cultivation of the soil, the growth of crops, the feeding of animals, and the maintenance of plant and animal health which result in improved yields per

acre and per animal. In this field there are great opportunities for officers of the extension services of the Department of Agriculture in securing the wider adoption of the best technical practices.

Opportunities for Scientific Workers.

In the adjustment of the various branches of primary industry to meet the altered marketing outlook, and in establishing new industries or finding substitutes for imported materials, there is abundant scope for useful war-time work, not only in grappling with immediate problems but also in visualising new problems the rapid solution of which would assist our war-time economy.

The expansion of the dried milk, dried egg, flax, cotton, linseed and tobacco industries will call for intensive work on the part of research and extension workers.

In the establishment of the linen flax industry, much experimental work is required on the production side to determine the areas best suited for the growth of the crop; on the processing side of the industry there is the application of modern water retting technique to Australian commercial production, and the investigation of the possibilities of applying recently developed decorticating processes (which dispense with the need for retting of the straw). Local growing of linseed for oil making is in the experimental stages, and much intensive work will be needed to determine the varieties, soil and climatic regions and the technique best suited for seed production.

Dried whole milk suffers from a variety of defects, among which are flavour, difficulty of effecting an easy suspension in water, and lowered vitamin content. There are sound grounds for believing that these difficulties will be overcome. The investigation of the methods of drying or pulping and freezing of eggs to attain a high degree of efficiency in the use of plant and equipment for the preparation and transport of material is essential if Australia is to benefit fully by the market possibilities for these commodities, especially if export of eggs in the shell becomes difficult owing to delay in shipping, or to shortage of refrigerated transport.

The expansion of cotton production is highly desirable during the war, and there is much scope for extension workers in improving production methods on the farm and in demonstrating the value of irrigation as a means of ensuring greater stability in production.

The available supply of nitrogenous fertilisers is likely to fall short of requirements for the sugar, fruit and market-garden industries. Pre-war requirements of sulphate of ammonia were 55,000 tons, and in addition several thousand tons of nitrate of soda were used. Local production of sulphate of ammonia may not exceed 30,000 tons. Substantial economies in the use of sulphate of ammonia and nitrate of soda could be effected, particularly in the fruit industries, by calling into use bacterial aid for the fixing of atmospheric nitrogen by legumes and utilising as far as is possible waste organic materials rich in nitrogen. This merely involves the early application of results of work conducted at various research centres during recent years.

With the cessation of supplies of vegetable and pasture seeds from Europe there is now an opportunity for the production in Australia of many

species of seeds that hitherto have been imported. Britain herself is likely to be short of vegetable seeds for the campaign of increased production of vegetables on which she is embarking.

An interesting example of the manner in which a local community has overcome difficulty caused by the cessation of imports in the case of potash for processing of dried fruit may be mentioned: Workers at Merbein have shown that the potash (hitherto imported from Germany) necessary for the processing of dried fruit may be secured by the slow combustion of vine cuttings and the leaching of the resultant vine ash. An acre of vine cuttings produces from 20 to 25 lbs. of potash, which is more than sufficient for the processing of the produce of an acre of fruit.

The local production of essential drugs—hitherto imported—offers possibilities for the cultivation of certain species of medicinal plants and the exploitation of suitable indigenous or acclimatised species.

Agricultural production is under the control of the States and the State Departments of Agriculture. The responsibility for stimulating production must therefore rest largely with them. The broad lines on which production could be stimulated have been indicated, and the only limit to the ability of Britain to fill her larder with foodstuffs is the total shipping tonnage available and her own storage capacity.

Government Participation in Agriculture*

By

A. F. Bell, M.Sc., D.I.C.,

Deputy Director, Bureau of Sugar Experiment Stations, Brisbane, Queensland.

There can be but few members of this Institute who have not, from time to time, given some thought to the implications of the increasing amount of what I have termed "Government participation in agriculture", but which is also variously described from different viewpoints as "protective legislation", "benevolent partnership", "regimentation", or "unwarranted and unwarrantable interference with the liberty of the subject".

In discussing the participation of governments in agriculture, the term is used in its restricted sense of regulation of agricultural production and marketing by specific legislative measures, and does not include measures generally applicable to the community at large, such as the regulation of wages and conditions of labour.

The Development of Legislative Control.

The intrusion of active government interest in agricultural production and marketing in Australia is comparatively recent and, in most industries, has had its beginning in measures designed to prevent, circumscribe, or eradicate outbreaks of disease among economic plants and animals. The fundamentals

* Presidential Address to the Queensland Branch of the Institute, 1st March, 1940.

of ætiology and epidemiology were established upon a sound experimental basis during the latter half of last century and legislative measures for the control of disease naturally followed. Against such measures (particularly in the rather innocuous form in which they have often been enacted and administered) there was no opposition in principle. The community at large appreciates the fact that the defences against contagious diseases cannot be allowed to depend for their efficacy upon the whim of the individual, but that responsibility and protective action must operate on a community basis. Indeed, this form of collective action is accepted in principle by even the most rugged individualists.

Legislation designed to control plant diseases was followed, in Queensland at least, by legislation prescribing minimum, or label, standards for commodities commonly purchased in bulk by farmers—for example, viability of seeds and constituents of fertilisers. Apart from the possible dishonest merchant, whose individualism had become unduly rugged, there could be little well-founded opposition to the principle and application of such laws. Indeed, when abroad, one has often been amazed to find how slow some other countries had been to adopt a similar policy on this matter.

Concurrently there developed a certain amount of legislation designed to protect the purchaser and consumer of agricultural products ; this involved the adoption of minimum grades of quality and certain standards of hygiene under which agricultural products should be prepared, packed and delivered. Although perhaps not sought by the producers, such legislation can scarcely be opposed in principle—nor in practice if the prescribed standards may be reasonably attained.

At this stage, however, we reach the point where the further regulation of production and marketing gives rise to energetic and even bitter controversy.

The farmer is by personal inclination an individualist. A long and close association with primary producers has convinced me that most men assume the arduous work and uncertain rewards of farming, primarily for the sake of the satisfaction of " being their own bosses ". The farmer's attitude to social questions will be influenced, then, consciously or unconsciously, by the individualistic concept.

It is often claimed that, provided the rights of fellow citizens are adequately safeguarded, there is no ethical justification for the intrusion of any outside body into the domestic economy of an agricultural holding (or any other business for that matter) ; that subject to this proviso, the producer should be allowed, should he so desire, to proceed without let or hindrance to economic disruption in the manner most congenial to himself.

With this claim I find myself in full accord, but perhaps I would not be in full accord with many of the claimants in the interpretation of that limiting clause " provided the rights of fellow citizens are adequately safeguarded ". In general, however, my summarised personal view is that the amount of

ethically justifiable regimentation of any industry is to a considerable extent dependent upon the degree of economic self-sufficiency of that industry.

In the days of small isolated communities, when persons traded by a simple system of barter, a farmer stood or fell by his own efforts ; if his produce was unsatisfactory he, and he only, suffered in consequence. In the present-day world of large communities and vastly expanded volume and range of production, the manipulation of exchange of goods has long passed from the individual to the community and, as far as the export and import of commodities is concerned, such exchange has become a matter for national negotiation and responsibility.

In the case of an exportable surplus of produce, whether or not sold by international arrangement, the standard of excellence, or otherwise, of the produce ceases to be solely a matter for the contributory producers but becomes a matter affecting the welfare of the nation as a whole. To quote a specific instance : The financial returns from Australia's exportable surplus of wool are an integral factor in the maintenance of the solvency of this Commonwealth : any action or omission which reduces the salability of that exportable surplus or reduces its value, will react not merely upon those engaged in the wool industry, but upon the welfare of every citizen of this Commonwealth. Surely then the Government of the country is justified in taking such legislative action as is necessary to preserve such certain minimum standards of quality as will maintain the exchange value of the wool.

Of paramount importance, perhaps, in the question of the ethics of government participation in agriculture, is the so-called artificial raising of price levels for primary products by their acquisition at fixed minimum prices, adjustments of exchange rates, payment of bounties and the like. There are, of course, an increasingly large number of primary products which are sold at such a stabilised price level instead of depending upon the age-old basis of supply and demand, with or without bull and bear market tactics. In other words, the community, through the Government, guarantees to the primary producer a steady monetary return for his products which is in excess of the average return which could be obtained in the open market.

But in return for such guarantees the primary producer must inevitably surrender a degree of his independence, or individualism. The local consumer has now become a partner in the business of primary production and is justified in ensuring a *quid pro quo* in the form of legislative control. Since he pays some of the piper's fees, he is entitled to call some of the tune ; he becomes directly interested in seeing that crop production is controlled within certain limits and, particularly, he now becomes materially interested in the relative *efficiency* of the primary producers and primary industries. That is to say, the community at large, in return for its contribution to the at least partial maintenance of a particular primary industry, now demands some share in the management of that industry and ensures that share by legislation.

This appears to be the hurdle at which individualists baulk. They can accept the principle of stabilised prices but do not concede that it entails their surrender of what they consider an inalienable birthright.

In latter years the world has heard much of soil erosion, and this question opens yet another phase of legislation affecting primary production, namely land tenure. It will, I think, be generally conceded that if a man buys a piece of apparatus he is more or less entitled to treat it to such attention or neglect as his mood decrees : it is but a transient material possession and may readily and gladly be replaced by industry. The ownership of land is a different matter. Land cannot be replaced or re-created, and therefore it would appear but reasonable to postulate that ownership of land is not absolute, but rather that the owner holds the land in trust for future generations. If we accept that viewpoint, and I think we must, then it is a necessary corollary that we must believe that the Government should take such measures as are necessary to ensure that the heritage will be held inviolate and the trust not abused.

Finally, a dispassionate observer will be forced to admit that during the past twenty years the initial requests for regulating legislation in primary industry have usually come *from the primary producers themselves*. True, they may not have correctly visualised what they were requesting, nor perhaps realised the inevitable consequential reactions resulting from the implementing of their requests ; or they may have received much more or much less than they actually requested. The increasing immensity of production, and the increasing complexity of distribution and exchange of primary products brings more and more primary producers, in their perplexity, to seek government aid for the " protection " of their particular industry. Thus most of the modern agricultural legislation is " protective " in intention, but protective legislation cannot be a purely external device ; it must necessarily overhaul, and sometimes reform, the internal structure and in the doing thereof some people are displeased.

Summarising these rather random and generalised observations, we see that there is a great deal of fundamental justification for the admittedly rapidly increasing extent of Government participation in agriculture. Greater knowledge of methods for the control of plant and animal diseases must be followed by more specific and more positive legislative measures ; barter and exchange have moved from an individual to a national basis—with all the structural changes that that implies. The stabilisation of prices of primary products, with the assistance and at the expense of the consuming community, confers on the community the status of a partner with a voice in the management of affairs. Primary producers themselves have been responsible for the initiation of crop control legislation.

So much for generalisations. Let us now proceed to the particular by an examination of the structure of the much regulated sugar industry.

Legislation Regulating the Sugar Industry.

The conditions of employment within the Queensland sugar industry are, as in the case of most industries in this State, regulated in detail by various Acts, and the Awards of the Arbitration Court. Except that somewhat higher rates of wages are paid, in order to compensate for the seasonal nature of the work, these conditions do not differ in principle from those applied to other industries and they need not be further considered here.

Production and marketing within the sugar industry are mainly controlled by the operation of three Acts (" The Regulation of Sugar Cane Prices Act ", " The Sugar Experiment Stations Act ", and " The Sugar Acquisition Act ") and an agreement between the State and Commonwealth Governments.

Sugar experiment stations were established in 1900 by the passage of the Sugar Experiment Stations Act, which has since been amended several times. The funds of the stations are endowed by the State to the extent of £7,000 annually, the remaining cost being borne in equal parts by millers and growers on the basis of a levy per ton of cane crushed. In his administration of these stations, the Minister for Agriculture is assisted by an advisory board consisting of two Government representatives, two millers and two growers. The Regulation of Sugar Cane Prices Act was first enacted in 1915 ; the Board created thereunder consists of a Supreme Court Judge as chairman, a millers' representative, a growers' representative, and two technical members—with restricted voting power—appointed by the Government.

Under the agreement between the two Governments there is an embargo against the importation of foreign sugar, and all sugar consumed within the Commonwealth is paid for at a price of £24 per ton of raw sugar ; the surplus over and above Australia's requirements is exported to other parts of the British Empire where it earns world's parity prices, plus any intra-Empire preferences. The Sugar Board, on behalf of the Queensland Government, is empowered to acquire the whole of the Queensland output, allot the necessary quota for home consumption, sell what it can overseas, and return to the producers a proportionate value of total proceeds. Thus the producer gets a reasonably stabilised return ; the fixed price received for home consumption sugar is very considerably above current world prices, but also very considerably below boom period world prices. The return for this export sugar helps to build up much-needed credits abroad.

Sugar cane is a very bulky crop, requiring elaborate systems of tramways for transport after harvesting. Lands on which sugar cane is grown are therefore " assigned " to a particular mill, and a farmer may deliver cane only to that mill to which his land is assigned. In addition to taking care of transport difficulties this system also prevents cut-throat competition between mills for available cane supplies.

In order to effect some control of production the assignments quoted above are given for a specified acreage, and it is further required that a farmer may

not harvest annually more than a fixed proportion (at present 75 per cent.) of that acreage. The average assignment in Queensland is approximately 40 acres gross—30 acres nett ; that is to say, the farmer may grow cane on a specified 40 acres but he may only harvest cane, for delivery to his mill, from 30 acres per annum. In defence of this system of specified assignments it must be said that it has to a considerable extent controlled production, and has achieved its avowed object of intensifying production per unit area. On the other side, it must be pointed out that (by restricting the cane to specified areas) it does not permit of that crop rotation which is now so desirable. From the point of view of agriculture the assignment of such a specified area has nothing to commend it and crop limitation by tonnage, or by finite, but unspecified, areas would serve the purpose better.

The assignment of the land is effected under the Cane Prices Act, which now gives way, so to speak, to the Sugar Experiment Stations Act until such time as the cane is harvested.

The Sugar Experiment Stations Act, by its most recent amendment, had incorporated within it all relevant principles of the Diseases in Plants Act, adapted to the special requirements of this crop and the conditions of its production. Moreover, the application of these principles is considerably more positive than is the case in most plant disease and pest legislation.

The usual course of plant disease outbreaks is as follows : An outbreak occurs among the generally susceptible varieties of an area and loss results ; gradually, and—in the past—by rule of thumb methods, resistant varieties are found and propagated and the outbreak abates. But the change over to resistant varieties, although almost complete, is not absolute and fractions of one per cent. of susceptible and diseased varieties are left in odd fields. After the outbreak has subsided the search for better yielding varieties goes on and gradually a considerable proportion of the area is replanted to susceptible varieties ; these become infected from the odd fields of the old diseased varieties and the cycle begins again. The uncontrolled introduction of a new variety may also be attended by very unhappy results if it be found susceptible to a disease already in a district ; owing to rapid propagation the variety may enjoy mass protection until it has been planted to extensive areas—then the particular disease invades it and losses are sudden and severe.

To guard against these, and similar situations, there has been instituted a system of variety approval. Each year the Director of Sugar Experiment Stations is required to issue, for each sugar mill area, a list of the varieties of sugar cane which are approved for planting in that area. Under the deterrent of fairly heavy penalties no person within that mill area is permitted to plant, grow, or even have in his possession any variety of sugar cane not so approved. (To safeguard economic interests and enable normal crop rotation, if a variety was approved when planted, but is subsequently disapproved, a farmer is

permitted to crop it up to the third calendar year after the year of planting.) Furthermore severe penalties may be imposed upon a sugar mill which accepts a non-approved variety for crushing.

At first sight this might sound a drastic provision, but in practice it is not so. In choosing the list of approved varieties the Director is required to give consideration to the disease resistance, agricultural qualities and milling qualities of each variety, but he does not make an arbitrary choice. Our extensive systems of replicated field trials furnish accurate knowledge of yielding qualities and disease resistance, and form the basis for a sound selection of varieties. In actual fact it is probable that the interests of each district would best be served by the growing of no more than three or four varieties and, indeed, in most mill areas the four most important varieties will constitute 90 per cent. of the crop in the absence of any measure of varietal approval. In practice, some six to ten varieties are approved for each mill district and this makes ample concession to any personal varietal prejudice ; indeed 98 per cent. of the growers will not be directly aware of any restriction. There does not appear to be any doubt that the effect of this system of variety approval tends towards increased yields and reduced incidence of disease.

No person may import sugar cane from abroad or from another State, this being the sole prerogative of the Bureau of Sugar Experiment Stations, which maintains adequate quarantine house facilities. Furthermore since several of its officers have travelled extensively abroad, and since it has many points of contact with foreign cane sugar producing countries, the Bureau is in the best position to judge the suitability of importations. Upwards of twenty thousand seedling canes are raised and tested each year so that the need for such importations is not great. In order to protect small stocks of newly imported or newly raised varieties, very heavy penalties are imposed upon persons guilty of unlawful possession of such experimental canes.

Very full powers are granted for the inspection of cane and detection of disease, and the system of quarantine has been made to mean something by fastening the guilt upon not only the person who takes cane across a quarantine boundary but also the person from whose property the cane was removed (with certain safeguards in the case of theft) and the person to whom the cane is delivered. In the case of quarantine districts, if it be suspected that certain cane has been brought into that district in contravention of quarantine regulations the farmer may be called upon to satisfy an inspector that it was not ; if he fails so to satisfy the inspector he is adjudged guilty of an offence.

The purist will see in this a violation of the principles of British justice in that the man is adjudged guilty until he can prove his innocence. But in practice the provision is equitable. If the man has obtained the cane from a legitimate source there will not be the least difficulty in his demonstrating the fact.

The ordinary mechanics of pest and disease control in canefields are vested in Pest and Disease Control Boards. Where deemed advisable the Minister may declare any particular area to be pest or disease infested, and a Control Board is thereupon created. The members of such Boards consist of three members elected by the cane growers and two members elected by the millers concerned. Funds are supplied by a levy on each ton of cane milled, growers and millers contributing equally. The levy is imposed under the Sugar Experiment Stations Act but the amount thereof is, in the first instance, recommended by the Board. These Boards enjoy almost complete autonomy, provided they work energetically with approved methods of pest and disease control, and they have so far functioned with marked success. They are required to have their audited accounts and reports published so that the contributors may see what they are getting for their money; in time of emergency the Boards may be superseded by the Advisory Board of Sugar Experiment Stations.

(Members may be interested, and perhaps surprised, to know that no minimum standards of cultivation of cane are required by law; perhaps this is because of the fact that, generally speaking, our lands are over-cultivated !)

When the cane is ready for harvesting it is cut and transported to the mill to which the land in question is assigned; unlike most primary commodities, the tramway system enables delivery to be made on the field and there the growers' responsibility for transport ends.

Payment for the cane is made on the basis of the recoverable sugar content of the cane, as determined by analysis and the application of an empirical formula known as the Commercial Cane Sugar or C.C.S. formula. This formula, after taking into account the cane sugar, fibre and impurities of the cane, proceeds to assess the amount of recoverable or commercial sugar on the assumption of a certain high standard of technical efficiency on the part of the mill. Thus the canegrower receives the computed value of his cane, and if the mill lacks efficiency the miller bears the loss—a necessary proviso where the mill enjoys a monopoly, as it does under the assignment system.

Analyses of cane are carried out by chemists employed by the mills, but, for the protection of the growers, the Cane Prices Board stations check cane testers at each mill in order to see that analyses are done correctly and in accordance with prescribed methods. Small matters in dispute may be referred to these representatives of the Board, and it is of interest to note that their services are widely used even in co-operative mills where every supplier is *ipso facto* a shareholder.

The allocation of payment per ton of sugar, as between miller and grower, was originally based on the estimate of the relative amounts of capital invested in farms and mills. Adjustments in this ratio of payments to miller and grower are made from time to time by the Cane Prices Board in order to meet changing conditions. Each year the Board makes an Award for each mill and

therein are set out in detail the conditions of sale of the crop, facilities to be provided by the mill, proportionate allotment of tonnages to farmers, deductions which may be made by the mill in respect of varieties which are difficult to mill, deductions for burnt cane, diseased cane, dirty cane and the like. In fact, every detail covering the exchange, including the date of commencement of crushing, is provided for—as, again, it must be in the case of a monopoly. In this connection, also, provision is made for the taking over of any mill which fails to observe the necessary conditions of sale or fails to operate in accordance with requirements.

Recently legislation has been enacted in order to exercise a firm control of production. Under the provisions of the International Sugar Agreement concluded in London in 1938, the amount of sugar which may be exported by any country in any one year is strictly limited. Therefore, the amount of sugar which can be sold by Australia in any year is this qutoa, plus the amount required for local consumption. Since the market is rigidly fixed it is, of course, necessary to fix the output of sugar both for the State and for each individual mill, and this has been done by allotting to each mill a proportionate share of the available market. The allocation was made on the basis of the recommendations of a Royal Commission and is very largely founded on previous production. It was, of course, not to be expected that such allocations would meet with universal approval—and they do not ; but that does not mean that they are necessarily inequitable.

The allocation of quotas to each mill having been completed, it is essential to proceed to control individual suppliers if chaos is to be avoided. For example, let us assume that the amount of cane necessary to fill a mill's quota is 100,000 tons. Before the commencement of the season estimates of the tonnage available in all fields are made and, again, let us assume that this estimate came to 120,000 tons. In such case there would be a proportionate allotment to each farmer, and a man who had 1,200 tons of cane in the field would be allowed to harvest 1,000 tons, and so forth. In the following year to ensure his delivery of 1,000 tons—or perhaps a little more—the farmer might set out to grow 1,500 tons and most of his neighbours would do likewise. In order to avoid the chaotic results of the mad production race which would result, the Cane Prices Act has been amended to provide for farm peaks—i.e. the quota to be allotted to each farm. The Act provides that, in the first instance, these peaks may be implemented by local agreement among the suppliers to each mill, appeal to the Board being available if agreement cannot be reached. Owing to the divergent local conditions at different points of the sugar belt, it is likely that the detailed methods of implementing the farm peak scheme will vary from mill to mill.

It is mandatory for farm peak schemes to be finalised during the current year. No doubt there will be many heart-burnings when the allotments are

completed, and certainly far from one hundred per cent. of the farmers will be satisfied. Since this legislation has not yet been put into operation its value cannot be judged ; no doubt some working imperfections will be found but, as with all other measures of this type, we should assess it not merely on the basis of any inherent faults it may have but on the magnitude of the evils it may have rectified.

Conclusions.

The outline I have given makes it very evident that the Queensland cane sugar industry is regulated to a very considerable degree through all phases of production. Our *South African Sugar Journal* contributor does not appear to be very wide of the mark in his assertion. How, then, has the sugar industry borne this flood of regulation ?

From the point of view of efficiency, I do not think it can be gainsaid that the sugar industry leads all other primary industries in Australia, and considerable overseas experience leads me to believe that it can compare favourably with any primary industry in any part of the world, conducted on the small farm basis. Within the cane sugar world, on the basis of sugar produced per acre per month, the Queensland industry certainly leads all small farm countries and, including " plantation " countries, it is only exceeded by Java and (to a less extent) Puerto Rico and Hawaii.

The Cane Prices Act gave a direct stimulus to the cultivation of canes of higher sugar content, and since its inception in 1915 the tons of cane required to make one ton of sugar have declined from 8·6 in the 1915 period to less than seven tons in recent years. The latter ratio is easily the best in the world.

In 1900, at the time of the passing of the Sugar Experiment Stations Act, the average production of sugar per acre was 1·2 tons, while in the 1938 season it was 3·1 tons* ; over the decade 1928 to 1938, it increased from 2·4 tons to 3·1 tons* per acre.

Over the 15-year period from 1923 to 1938, the average price paid for raw sugar declined from £30 6s. 8d. per ton to £15 2s. 2d. in 1938. That is to say, the returns to the producer have virtually been halved—yet it would appear that the financial position of the industry is more stable at the present time.

In the face of this evidence one cannot come to any conclusion other than that the " protective " or " regulating " legislation, enacted from time to time, has produced a remarkable increase in field and mill efficiency. The general financial position of canegrowers is at least as good as that of any other primary industry organised in units of similar size, while if their personality is being stifled they do not appear to be acutely aware of it. One cannot recognise the canegrowers in a community by any increased symptoms of repression.

* 3·41 tons in 1939 season according to statistics released after delivery of this address.

In conclusion, then, if we may judge from the progress of the Queensland sugar industry and those engaged in it, dire results need not necessarily follow the institution of a considerable degree of protective and regulatory legislation. On the other hand, it should at the same time be emphasised that the framers and administrators of such legislation in respect of the Queensland sugar industry have always had at their command the services of an extensive technical service. No doubt it all depends on the form of government available, for, as Albert Jay Nock has said, the granting of power to do things *for* you carries with it an equivalent power to do things *to* you.

Erosion Control in Victoria*

MEMORANDUM BY JOINT COMMITTEE OF INSTITUTES

The problem of soil erosion has become a critical national issue in many countries, and in some of these tremendous sums of money are being expended in an endeavour to conserve the greatest of all natural resources—the soil—with all that this implies. It is widely recognised that in the State of Victoria this problem is becoming serious. Several committees and experts have reported on the matter. Lectures and press articles have done much to stimulate public interest.

At the invitation of the Council of the Victorian Institute of Surveyors, which felt that the considered opinion of the professional organisations concerned with the soil would be of value to the Government in its deliberations on soil erosion, the following institutions appointed representatives to confer :

Victorian Institute of Surveyors.
Institution of Engineers, Australia (Melbourne Division).
Australian Institute of Agricultural Science (Victorian Branch).
Institute of Foresters of Australia (Victorian Division).

This Committee felt that the publication of varying opinions as to causes, effects and cures was dividing those who should be united in a common cause. It has, therefore, studied the problem of erosion in this State and elsewhere, and has considered the steps which are being taken in other States and countries to combat erosion and to promote effective husbandry of the soil. It submits the following opinions and recommendations in the firm belief that action is urgently necessary. Although the action proposed may not be a complete or final solution, it constitutes a sound foundation on which an adequate and effective organisation may be built.

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* This Memorandum has received the approval of each of the Institutes mentioned in the text, and has been presented to the Victorian Cabinet Sub-Committee on Soil Erosion Legislation, 1940.

Scope of the Problem.

So far no detailed State-wide assessment or investigation of the problem of soil erosion has been conducted. It is, therefore, impossible to state the total losses in terms either of acres affected, or of actual cost. It is, however, certain that the menace in one form or another already affects an area in Victoria which runs into hundreds of thousands, and probably millions of acres. It seems clear also, that in some districts the rate of damage is accelerating. It will continue to do so unless steps are taken to arrest its progress.

The prevention or control of soil erosion is bound up with the correct use of land.

The land user should, under proper guidance, almost invariably, be able to develop a scheme of agricultural or pastoral management which would safeguard the soil against erosion. However, the responsibility to assist and advise him rests with the State.

Method of Attack.

The method of attack proposed is by the establishment of a part-time expert advisory authority. Its function should be to formulate the principles of soil conservation and, so far as is necessary, to the control of erosion, of land utilisation ; and to establish and extend the application of these principles through the cooperation of existing authorities.

Coercive legislation should be undertaken only if recommended by this authority in the light of experience.

The creation of a separate department or sub-department to deal with erosion should not be necessary.

Some preventive and remedial measures will call for considerable expenditure by public bodies and individuals. A proportion will be immediately profitable ; *all* will result in ultimate saving or profit.

Constitution and Organisation.

A board composed of technical experts in the various aspects of land utilisation together with representatives of rural interests would be best able to deal with the problem. A part-time board would suffice. It should be so constituted that its members could carry out much of their work of soil erosion in association with their ordinary duties.

The following constitution is recommended :

One representative each from grazing and farming interests, and one technical officer from each of the undermentioned bodies :

Department of Lands and Survey.
Department of Mines.
Department of Agriculture.
State Rivers and Water Supply Commission.
Forests Commission.

Our Committee considers that the greatest measure of cooperation would be achieved and that the community would be best served if the board operated under the Premier's Department.

With the exception that it provides for representation of rural interests, the proposed board would be similar in constitution to the " Soil Conservation Committee " recommended by the Erosion Investigation Committee ; and to the " Land Utilisation Committee " recommended by the Royal Commission on Bush Fires.

It is suggested that the board should :

(*a*) Appoint sub-committees, including specialists, not necessarily members of the board, to consider special aspects or divisions of the problem.

(*b*) Appoint sub-committees on a regional basis (as for example a catchment) each charged with the duty of studying land utilisation in its particular area and reporting to the board.

Staff. The Committee considers that the board will require a full-time staff consisting of at least one executive officer, who need not necessarily be a member of the board but who should attend its meetings, a secretary and clerical assistance.

The executive officer should be of a grade not lower than Class " B " Professional Division of the Victorian Public Service, and should have already acquired some intimate knowledge of the characteristics and use of land.

The appointment should be subject to the Public Service Act.

Duties of the Proposed Board.

The board should, through its own members, executive staff and sub-committees, and the several departments and other authorities :

(*a*) Advise the appropriate departments, public corporations and land users concerning the control of erosion throughout the State and, where necessary, indicate the most appropriate use of lands liable to erosion ; i.e. whether they should be employed for cropping, grazing, forestry, or other purposes. (Copies of any recommendation to a department should be supplied to each other interested department).

(*b*) Conduct a survey of erosion through the State.

(*c*) Conduct further investigation and research into the cause, prevention, and mitigation of erosion.

The board should further :

(*d*) Institute measures of an educational nature (pamphlets, demonstrations, lectures, etc.).

(*e*) Report annually to Parliament on its activities and the measure of cooperation received from departments.

(*f*) Recommend to Parliament such additional legislation as is desirable.

Departmental Co-ordination.

The board should seek the cooperation of the departments. In view of the extreme importance of the problem and for the general welfare of the State, the departments should be authorised and directed to afford the necessary cooperation and, further, they would as a matter of routine inform the board of any action they were taking in connection with soil erosion.

Departmental engineers, surveyors, foresters, agricultural officers, Crown Lands inspectors, water rangers, who are stationed in the country, have specialised as well as general knowledge of their districts. In addition, many senior technical officers are continually travelling in the country in the course of their duties. The services of both travelling and country officers could be used without any great disturbance of their work. Contacts between them, especially those of an inter-departmental nature, would be of mutual benefit. This arrangement would also lead to more efficient and better co-ordinated departmental service to the public.

Section 15 of the Closer Settlement Act, 1928, and section 12 of the Country Roads Board Act provide for the use of officers of other departments. This is also the basis of the Survey Co-ordination Bill. It resembles the method used by the U.S.A. Soil Conservation Service where officers of many departments, known as " dollar men ", are paid one dollar per annum by the Service as a retainer.

Powers.

If the constitution and duties of the board are agreed to as recommended in this memorandum, the board will not require many special powers. Most of those necessary are already included in the several Acts under which the departments operate. The board should, however, be given :

(*a*) The specific power to enter upon any land.

(*b*) The power to make grants or loans to any body or person for carrying out specific projects in furthering the objects of the board.

(*c*) The right to require the production of appropriate records by any department.

Finance.

Continuity of effort is fundamental to success in erosion control. The basic activities of the board should, therefore, be financed from a trust fund. A special appropriation should be made to this fund by Parliament for a period of years.

With the organisation proposed, the direct cost, allowing for salaries, travelling, propaganda, office expenses, etc., would be about £5,000 per annum. This, however, does not make full provision for investigation, research and demonstration, arrangements for the conduct of which activities should generally be made in cooperation with existing departments ; nor does it provide for any grants or loans. The board should, from time to time, submit estimates for such work.

The Citrus Red Scale Problem in New South Wales

WITH SPECIAL REFERENCE TO FUMIGATION

By

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Red scale (*Aonidiella aurantii*) has been known as a serious pest of citrus ever since the early days of the industry, and has been well established in all the eastern States for over half a century. According to Quayle,[15] red scale was brought from Australia to California between 1868 and 1875 and has since become the principal pest in the citrus industry of that State. It is also the principal pest of citrus in South Africa, and is recorded in different degrees of importance from practically all areas where citrus is grown.

Control Measures in N.S.W.

Before the introduction of the fumigation method, control measures adopted consisted largely of sprays of kerosene, blue oil, or resin soda wash, but these were only partially successful even though applied several times during the season.[1] From early in the century until about 1914, fumigation by the pot method was extensively practised, but owing to increased costs during the war period, 1914-18, this method largely fell into disuse, and sprays of miscible red oil or resin soda were resorted to. Early in the 1920's, however, red scale development became acute, particularly in the extensive new plantings which were made at that time, and considerable attention was focussed on the red scale problem. Brown,[6] in describing this period, remarks: "In the early days of the present decade . . . there was a regular invasion of many citrus districts by red scale, which was observed to increase season by season . . . growers remarking that it came like a dust cloud".

Spraying failed to hold scale in check, and the oils used at that time were often responsible for considerable tree injury. Attention was then given to fumigation, and the dry calcium cyanide dust method—introduced and tested in the Leeton district by H. J. Quayle whilst on a visit to this country—soon attained great popularity. An enormous extension of commercial fumigation took place during the next few years, and in the 1926 season some 3,000 acres were fumigated, chiefly by the use of the "Cyanogas" calcium cyanide method.[5] Although results generally were fairly satisfactory, some poor kills occurred and, in addition, some severe tree injury was caused, particularly as most of the work was done in daylight.

Refined white oil sprays were introduced about 1927, and owing to their safety and effectiveness were widely adopted, and fumigation—particularly

on the coast—declined. At about the same time, another revolutionary development in fumigation methods occurred when the high grade calcium cyanides came on to the market, accompanied by an ingenious method which utilised granulated diatomacious earth as a carrier for liquid hydrocyanic acid. This latter principle had been used with success in fumigants for ship and domestic fumigation, but although partially satisfactory in citrus work, was soon discarded owing to the rather dangerous nature of the product and to the variation in results obtained.

The high grade calcium cyanide dusts were very promising but were soon superseded by the briquette form in which 85 per cent. calcium cyanide was put up in tablets, capable of liberating 10 grams HCN per tablet on being ground and blown into the tent space with a special machine. This material had a wide appeal on account of its simplified application, safety and cleanliness and most commercial fumigation carried out since 1930 has utilised this method.

Liquid HCN was first used in this State in 1933 in experiments conducted by the writer,[8] although it has been in use in California since 1917. Results were satisfactory at rates approximating the standard for calcium cyanide, but the manufacturers did not make the material available in quantities sufficient for commercial fumigation. Difficulties of transport were the principal obstacle to its use here, but the material used in 1933 was a locally made product put up in small canisters. In the 1936 season commercial supplies of liquid HCN, together with suitable applicators, were available and this method has been used to a small extent since that time.

Owing to the present war the outlook for fumigation during next season is uncertain. Calcium cyanide briquettes are not likely to be available and some difficulty in procuring liquid HCN may be expected and it seems probable that the pot method will return to favour again.

Fumigation Dosage.

Allen,[1] in 1899, introduced the pot method of fumigation which made use of the HCN gas evolved by the interaction of potassium cyanide, sulphuric acid and water. This method had been fairly well standardised in California by Coquillet[15] and Allen indicated that under local conditions satisfactory results were obtained by using 1 oz. KCN per 200 cu. ft. However, in 1913,[2] owing to the less satisfactory results sometimes obtained, Allen issued his revised No. 2 table which called for 1 oz. KCN per 175 cu. ft. and recommended the use of this table for heavy infestations. As the Californians[19] had by this time substituted NaCN for KCN in their dosage tables, this new table of Allen's was equivalent to 44 per cent. of the standard Californian table.

When Quayle introduced and tested the dry calcium cyanide method at Leeton in 1922,[14] he utilised the Californian dosage schedules but it was soon found in practice that lower dosages could be used,[3] and much use was

made of Allen's No. 2 pot method table with ounces of $Ca(CN)_2$ substituted for ounces of KCN. Arthur and Harrison[4] confirmed this view and as a result of their experiments, stated that, " . . . indications are that even this (dosage) is in excess of actual requirements ".

Assuming the yield of HCN from KCN (98-100 per cent.) to be in the vicinity of 97 per cent.[17] the charge according to Allen's No. 2 table was about 11 grams HCN per 175 cu. ft. With " Cyanogas " $Ca(CN)_2$ of 45-50 per cent. purity the total yield would be between 6·3 and 7·9 grams HCN per ounce. Used at the Allen No. 2 table rate, the charge would therefore be only 57-72 per cent. of the pot method, even under conditions suitable for the full yield of gas during the 45 minutes period of tree coverage, and would also be equivalent to only 25-33 per cent. of the full Californian dosage.

Benton,[5] in 1927, concluded that the Allen No. 2 table was a minimum rate for Cyanogas, and Woodhill,[20] in 1930, stated that this dosage of Cyanogas was definitely unsatisfactory, that even the increased rate of 1 oz. per 100 cu. ft. sometimes gave a poor kill, and he suggested further increase in dosage.

From the above summary it is seen that dosages as low as 44 per cent. of the Californian rate had been used successfully with the pot method, and even as low as 25 per cent. of this schedule with Cyanogas.

It was considered by the writer, after a large series of comparative experiments in different districts, that although slightly better scale kills were sometimes obtained with higher dosages, the standard rate for all fumigants should be in the vicinity of 6 grams HCN per 100 cu. ft. for average sized trees (28 ft. by 40 ft.) with suitable increases or decreases according to relative size.

As a result of these experiments it was concluded that under good fumigating conditions at night, the effective gas yield from Cyanogas A dust was about 75 per cent., and from 98-100 per cent. KCN about 82 per cent. On this basis, the following approximate equivalents were determined :

1 briquette (85 per cent. $Ca(CN)_2$)=2 ozs. Cyanogas=1·11 ozs. KCN= 15 c.c. liquid HCN.

For practical field purposes it should be adequate, therefore, to utilise the standard briquette chart with any fumigant by simply reading 2 ozs. Cyanogas, 1 (14 c.c.) unit liquid HCN, or 1 oz. NaCN, for each briquette called for on the table. In regard to the pot method, NaCN should be substituted for KCN in any case, on account of its higher unit value.[18]

Factors Affecting the Efficiency of Fumigation.

Apart from the question of dosage, several other factors have been considered as influencing fumigation, both as regards scale kill and tree injury.

Light. Fumigation (particularly with the high and low grade calcium cyanides) has frequently been practised successfully in daylight ; nevertheless, much of the injury which has at times occurred in commercial work has been definitely due to daylight work, particularly under warm, moist conditions.

Excepting in winter, all work should be confined to the night time. It is well known also that better scale kills are obtained in night work owing to the fact that air movement is then usually not so marked.

Temperature. This factor alone is not important, particularly in night work, though low temperatures (below 45° F.) are considered to be dangerous. As very little work would ever be likely at such temperatures in this State, this is of little consequence. It is frequently held that scale kills are reduced at low temperatures and that the dosage should be increased for temperatures, between 50-70° F. There is no definite evidence to support this view.

Humidity. Whilst this factor appears to be important with Cyanogas, it is much less so with other fumigants and it seems unlikely that there is any significant difference in the gas yield under the ordinary atmospheric conditions met with. Injury to the trees is, however, more likely to occur at high humidities, especially if accompanied by high temperatures. Lemons fumigated with Cyanogas at high humidities are liable to suffer severely, oranges much less so. Free moisture such as rain or dew is a disadvantage as the sheets pick up grit and sand which may seriously damage fruit by abrasive action.

Atmospheric Movement. This has been shown to be important in experiments and in practical fumigation, and work should not proceed if wind movement is sufficient to flap the sheets. It has been found[13] that wind speeds above 2·5 miles per hour might cause this tent flap.

Tent Quality. Light-weight sheets are often blamed for inferior scale kills being obtained, but this is not necessarily true. In a number of trials of different quality sheets which the writer has carried out, no decided difference has been seen between heavy 12 oz. duck and various grades down to about 5 oz. calico. Toughness and durability are, of course, essential particularly for use by commercial batteries but at the same time, ease of handling and cost also must be considered.

Type of Gas Concentration. Much controversy has raged around the question of quick-high concentration versus slowly developing gas concentrations. Gray and Kirkpatrick's findings in California[7] that resistant red scale insects had the capacity of resisting high concentrations of HCN gas if previously subjected to a low non-lethal concentration, gave a great fillip to the popularity of the quick-acting fumigants. In the writer's experience this factor of " protective stupefaction " is of little importance in field practice, and equally good results are obtainable at equivalent dosages under suitable conditions irrespective of the type of concentration beneath the tent.

Survey of Commercial Fumigation.

During the 1939 season a survey of commercial fumigation[10] on the Murrumbidgee Irrigation Area was conducted by the district entomologist, Mr. E. J. Wason, and the writer, in collaboration with officers of the Fruit

Branch of the Department of Agriculture. The aim was to determine to what extent measurable factors were responsible for variation in scale kill over a wide variety of conditions. Unfortunately, the high natural mortality induced by the January heat wave masked and confused the results to some extent, but some of the findings are detailed below.

(1) No clear correlation was found to exist between percentage scale mortality and such single factors as temperature, humidity, wind, time of treatment or size and shape of tree. Nor was there any indication that an increase of 10 per cent. on the standard dosage rate (calcid briquettes) gave improved results.

(2) Equally good results were shown where fumigation was carried out under conditions of high temperature and low humidity, or at low temperatures and high humidity.

(3) Scale on mature fruit (Valencias) was not necessarily more difficult to kill than that on green fruit, though such mature fruit on trees did render the task of effective scale control much more difficult.

(4) Definite evidence was seen of scales in the " grey adult " and second moult stages being more resistant to fumigation than those in other stages.

(5) Individual trees or groups of trees were seen on which scale mortality was decidedly lower than on the remainder. No satisfactory explanation of this phenomenon was available, though there was some suggestion that it might be a function of the nutritional conditions provided by the host plant itself. A very similar type of circumstance was revealed in the variation in natural mortality of scale due to heat wave conditions. Individual trees were sometimes seen on which natural mortality was practically nil, whilst on adjacent trees it approached 100 per cent. Such trees, in all instances, had the appearance of decidedly greater vigour than the remainder of the trees.

Recent Trends in Scale Control Measures.

The tendency as shown in this State to increase dosages in the hope of developing a treatment which will be effective for a longer period is also seen in California where, at present, dosages up to 130 per cent. are now commonly used in certain " resistant " scale areas and in winter fumigation. Quayle and Ebeling[16] have attacked the problem from another angle and, in attempting to overlap the weaknesses inherent in the two principal scale control methods (oil spraying and fumigation), developed the skeleton spray-fumigation combination treatment which, although more expensive, has proved satisfactory where such measures are warranted.

Recent experiments[11] at Grafton showed clearly that even where drastic measures, involving combinations of spraying and fumigation, were adopted in winter on heavily infested trees, scale development during the late summer

and autumn was sufficient to largely offset the advantages gained from the early treatments. Where summer treatments were introduced after early treatment, the results were highly satisfactory.

Victorian workers[12] have shown that the residual value of treatment in one year is important in the following season, and scale control measures must be determined on a basis of initial infestation. Thus, on a heavily infested tree, treatment will be necessary before February, otherwise much scale may have already blemished the fruit, though there will still be ample time for the survivors from such treatment to build up considerably, especially on late hanging Valencias. Under such circumstances, a spray treatment in December followed by fumigation in March would probably be the best procedure. If infestation is sufficiently reduced in the following season, fumigation alone may be adequate.

Future Development.

At the present time the most satisfactory fumigant available for red scale control is HCN gas in some form, and where properly used this fumigant can generally be relied upon to give a highly satisfactory kill of scale. There seems little chance at present of any great improvement in scale kill being obtainable by modification of present methods. Nor does there appear to be much likelihood of substantially improving the technique of fumigation.

The spray materials available are still capable of improvement, though any advantage which may be gained is dependent always on the equipment available and the actual practice of spraying.

It seems to the writer that in order to obtain adequate control of red scale in those districts where it is a permanent problem, there must be a full realisation of the principle that results are dependent upon the percentage kill in relation to the initial infestation. Infestations must, therefore, be considered according to their merits and a treatment which may be satisfactory for light infestations will be of little use where the population is heavy.

The principle of programme treatments, modified as infestation fluctuates, from season to season, offers the best solution of the problem, and future developments in investigational work should aim at determining the most satisfactory, and at the same time economical, schedules which can be recommended under different conditions.

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The American Hybrid Maize Programme

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Introduction.

Maize is the principal agricultural crop grown in the United States of America, and according to a statement in the 1936 U.S. Yearbook of Agriculture by Dr. Merle T. Jenkins, Principal Agronomist, Bureau of Plant Industry, it exceeds in production and value the combined crops of wheat, oats, barley, rye, rice and buckwheat. In 1938, which is the last year for which statistics are at present available, the area sown to maize in U.S.A. was 91,792,000 acres and the total production was 2,542,238,000 bushels. The twelve corn belt states of Iowa, Illinois, Indiana, Minnesota, Ohio, Nebraska, Missouri, Wisconsin, Michigan, Kansas, South and North Dakota, were responsible for 58 per cent. of the total acreage and 70 per cent. of the total maize production.

Until the advent of the hybrid programme maize improvement methods were based essentially on selection. Mass selection for type and quality, largely based on arbitrary standards set up by maize judges at grain shows, has been practised for many years and has been responsible for the evolution of many of the existing open pollinated varieties. Ear to row methods of selection, including the remnant method of improvement and other modifications, received a good deal of attention in the first quarter of the present century but, generally speaking, yielded disappointing results and failed to effect any greater improvement that might have been accomplished by mass selection.

Mass selection is still the most practical method of maintaining the quality and yielding ability of open pollinated varieties adapted to particular environmental conditions. Selection, however, creates nothing new but merely serves as a means of isolating particular types which appear to be desirable. Moreover, in a cross pollinated crop like maize, selection for ear characters is based entirely on expressions of maternal inheritance, since there is no way of determining the qualities of the unknown plants which supplied the pollen.

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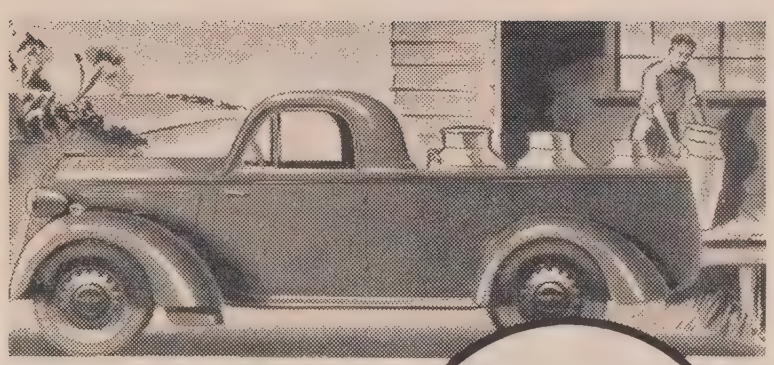

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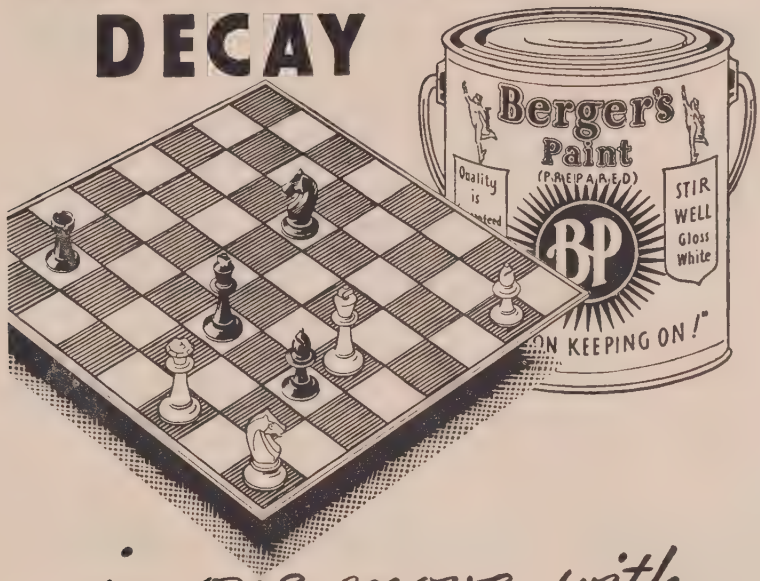

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Attempts to improve open pollinated varieties have now been abandoned in the main maize growing States, and the synthetic building up of hybrid strains by inbreeding and hybridisation has been adopted. This hybrid corn programme has achieved phenomenal success and is one of the most outstanding developments in farm crop production in recent times.

The Hybrid Programme.

The hybrid maize programme is based essentially on the work carried out between 1905 and 1909 by Shull at the Experiment Station of the Carnegie Institution of Washington, Cold Spring Harbour, New York, and by East at the Connecticut Agricultural Experiment Station. These workers, although primarily interested in genetical considerations, developed inbred lines of maize and showed that hybrids between such lines gave considerable yield increases over the parental varieties. Shull, in 1909, suggested as a practical method of maize breeding the production and maintenance of superior near-homozygous lines and their annual crossing for the production of F_1 seed for sale to commercial growers.

Following the work of Shull and East, maize improvement programmes involving the hybridisation of inbred lines were initiated at several of the agricultural experiment stations, but little progress was made until after 1920, when Jones of Connecticut showed that the double cross was a practical means of obviating the inherent difficulties associated with the commercial production of single cross hybrids.

Subsequent to 1920 the hybrid maize programme expanded rapidly, and in 1925 a committee was appointed to formulate a cooperative programme of maize improvement under the Purnell Act. Commenting on the work of this committee in the 1936 Yearbook of Agriculture, Dr. Jenkins said that it resulted in a plan for a group attack which had an important influence in coordinating the research, in developing a very free interchange of breeding material and in promoting far more rapid progress than otherwise would have been possible.

The adoption of the top-cross (variety × inbred) as a means of determining the yield prepotency of inbred lines, and the work of Jenkins showing the fixation of favourable yield factors within the first two generations of inbreeding, thus enabling yield potentialities to be determined at an early stage of the breeding programme, were both factors of considerable importance in simplifying the technique of hybrid maize production.

The Technique of Hybrid Maize Production.

The first step in the production of hybrid maize is the selection of desirable types within open pollinated varieties. These selections are then inbred by self-pollination for several generations, and by selection within the inbred lines many obviously undesirable types can be eliminated. After several generations of selfing, the yield factors in the selected inbred lines are sufficiently fixed to enable reliable determinations to be made of the yield prepotency of the various inbreds. There is not sufficient correlation between yield prepotency and visual plant characters to enable yielding ability to be determined by selection, and, consequently, crossing tests have to be made in order to evaluate the various lines.

The usual method of testing yield prepotency is by means of the top-cross in which the inbred lines are crossed with a standard open pollinated variety,

using the variety as the pollen parent. This procedure is readily carried out in an isolated crossing block in which the inbred lines are interplanted with the open pollinated variety. All the inbred lines are subsequently detasselled and the various crosses are then made automatically by natural pollination from the variety. The seed resulting from these top crosses is then yield tested against the variety for two or three years in order to obtain an adequate evaluation of the breeding potentialities of the inbreds, since there is a direct correlation between the yield prepotency of inbreds and their performance in top-crosses. Some crosses will yield considerably more than the open pollinated variety whilst others will be inferior, depending on the inherent yield prepotency of the individual inbred lines.

A restricted number of inbred lines possessing the highest yield prepotency and which show no obvious morphological or physiological defects are then crossed with each other in all possible combinations to produce a series of single crosses (inbred × inbred). Thus 10 inbred lines will yield 45 single crosses, while 20 lines will yield 190 single crosses. The single crosses are then evaluated for yielding ability and other desirable agronomic features such as grain quality, strength of stalk, resistance to lodging and ability to withstand diseases and insect pests. The best of the single crosses are then combined with each other in all possible combinations to produce the double crosses (single cross × single cross). The yielding ability and agronomic features of the double crosses are then evaluated in replicated field trials and the superior combinations are determined according to a performance rating. It is this double crossed seed that is eventually released for planting the commercial crops.

During the first five or six generations of inbreeding the self pollination is done by hand, but thereafter the lines are sufficiently stable to enable them to be carried on by sib pollination. This is done by growing individual lines in isolated blocks and permitting inter-plant pollination within the line. Experimental single crosses are likewise effected by hand pollination, but commercial single crosses are made in isolated crossing blocks by planting one row of the male parent to every one or two rows of the female parent, depending on the pollen producing capabilities of the paternal inbred. All plants of the female parent are then detasselled prior to the shedding of any pollen, and fertilisation is thus effected only by pollen from the male parent. The single crossed seed is therefore produced only on the maternal inbred. The grain produced on the pollinating line has been sibbed, and accordingly is available for the reproduction of the parental line the following season.

The double crossed seed is likewise produced in an isolated crossing block, but owing to the fact that single crosses produce pollen more abundantly than do inbred lines, only one row of the male parent is planted to every four rows of the female parent. All plants of the female line are detasselled, pollination is effected by the male parent and the double crossed seed is then produced only on the plants of the female parent.

The Nature of Inbred Lines.

Inbreeding resolves an open pollinated variety into some of its component parts and readily isolates lines that are homozygous for sterility factors, chlorophyll deficiencies and other undesirable features which prevent open pollinated maize achieving the maximum productivity. The inbreds are

remarkably uniform within lines, but vary enormously between lines in both morphological and physiological characters. The fixation of characters is very rapid and a high degree of genetic stability is attained within five or six generations of inbreeding.

All inbred lines of maize show a marked reduction in yielding ability and vegetative vigour when compared with the open pollinated varieties. In a paper presented to the Seventh International Genetics Congress at Edinburgh in August, 1939, Dr. E. W. Lindstrom of the Iowa Agricultural Experiment Station, stated that if the parental varieties yielded 60-70 bushels per acre the top 10 per cent. of inbreds produced only 30-40 bushels, whereas the best 10 per cent. of hybrids would yield 100 bushels under similar levels of fertility. Dr. Lindstrom also stated that of the 5,000-6,000 original inbred lines derived from the best varieties in U.S.A., only about 40-60 could be classed as good lines, and each of these had certain defects in addition to its low yield.

Inbred lines vary considerably in their reaction to different fertility levels, and nutrient culture and field experiments have demonstrated marked differences in ability to utilise low levels of phosphorus and nitrogen supply Marked differences in stalk strength, ratio of root to top growth, and extent and efficiency of root systems have also been demonstrated. Well defined differences in reaction to certain diseases and insect pests have also been found in various inbred lines.

Rapid Expansion of Hybrid Maize Acreage.

The first lot of commercially produced hybrid maize was grown in Connecticut in 1922. Between 1923 and 1926 it was grown by a few commercial growers in Illinois, Iowa, Ohio and Indiana, but it was not until ten years or so later that any substantial areas were sown with hybrids. Since 1936, however, the rate of increase in hybrid sowings has been phenomenal. The following figures, released by the Iowa Corn Research Institute, show the percentage of the total maize areas in this State which were sown with hybrids from 1933-1939 (Iowa is the main maize producing State in America, and grows about 10½ million acres each year) :

1933	0·4 per cent.
1934	1·4 ,,
1935	3·1 ,,
1936	5·3 ,,
1937	13·0 ,,
1938	52·0 ,,
1939	75·0 ,,

In Illinois, where about 8½ million acres of maize are grown each year, the same type of phenomenal increase has occurred. The following figures, taken from a bulletin compiled by experiment station workers and issued by the Illinois Farmers' Institute, show the manner in which hybrid maize acreages increased in this State between 1934 and 1938.

1934	5,000 acres
1935	35,000 ,,
1936	250,000 ,,
1937	1,000,000 ,,
1938	5,000,000 ,,

Increases of a similar nature have occurred also in the other important maize producing States such as Ohio, Indiana, and Wisconsin.

In a paper dealing with the economic aspects of hybrid corn, Dowell and Jesness (Jour. Farm. Econ., 21 : 479-488, 1939) state that in the 12 corn belt States the area sown with hybrids increased from 186,000 acres in 1934 to 16,000,000 acres in 1938. The latter figure represents about 31 per cent. of the corn belt maize acreage and about 18 per cent. of the total area sown with maize in U.S.A.

Estimates made by experiment station workers in each of the corn belt States indicate that eventually hybrid maize will be grown on 75-95 per cent. of the total maize acreage in eight of the twelve States, and that in the other four States (Michigan, Nebraska, North and South Dakota) it will be grown on 50-60 per cent. of the maize area. Estimates for the time when these totals will be attained range from 1939 to 1948 for the various States.

Advantages of Hybrid Maize.

Hybrids which regularly outyield the best of the previously grown open pollinated varieties are now available for many parts of the American corn belt. Many of these hybrids are considerably more resistant to drought and wind injury than were the parental varieties, and some also show an appreciable measure of resistance to certain insect pests and diseases. The most outstanding example of a disease resistant hybrid is Golden Cross Bantam sweet corn, which was developed at Purdue University and is highly resistant to bacterial wilt (*Aplanobacter stewartii*).

The commercial crops of hybrid maize are characterised by a remarkable uniformity of growth and maturity. The plants remain erect until harvest and there is little evidence of the lodging and breaking-over of stalks that is so common in open pollinated varieties. However, the main reason for the widespread adoption of hybrids is their ability to produce greater grain yields than do the varieties. Apart from increased yields associated with hybrid vigour, the productivity of the hybrids is largely due to the elimination of sterility factors in the component inbreds, as the hybrid crops show little, if any, evidence of barren stalks and nubbin-ear producing plants which are often prevalent in open pollinated maize.

Abundant data concerning the increased yields of hybrid maize are available but only one or two examples will be cited. Figures displayed by the Iowa Corn Research Institute at the International Genetics Congress in Edinburgh last year provided an interesting comparison between the average yield of the best hybrids and that of the open pollinated varieties in the extensive yield tests conducted at various locations in the four sections of that State in 1938 :

	Open Pollinated Varieties.	*Hybrids.*
Northern Iowa	59 bushels per acre	79 bushels per acre
North Central Iowa	73 „ „ „	91 „ „ „
South Central Iowa	65 „ „ „	84 „ „ „
Southern Iowa	57 „ „ „	75 „ „ „

In the 1939 corn yield test results published by the Iowa Agricultural Experiment Station in February of this year, the average yield of the hybrids was higher than that of the open pollinated varieties in each of the 12 districts

where tests were made. The advantage in favour of the hybrids varied from 5 to 41 per cent. increase in yield. Comparative yield test results of hybrids and open pollinated varieties for these 12 districts are now available for a period of 14 years, from 1926 to 1939 inclusive, and examination shows that during the first seven years of this period the hybrids had an average advantage of 8·8 per cent. increase in yield. The results for the second seven-year period clearly reflect the progress that has been made in the production of superior hybrids since 1933, as the average yield advantage of the hybrids in all districts for this period amounted to 17 per cent.

During the Spragg Memorial Lectures on Plant Breeding at the Michigan State College in April, 1938, Mr. H. A. Wallace, U.S. Secretary of Agriculture, and incidentally also one of the first commercial producers of hybrid maize, said :

" Looking ahead, we can be fairly certain that in 1945 there will be well adapted commercial strains of hybrid corn for practically every section of the corn belt that will yield at least 20 per cent. more than the average open-pollinated corn as grown in the respective parts of the corn belt in 1920."

The extent to which open pollinated varieties are being replaced by superior hybrids is also shown by the fact that the first Corn Improvement Conference held in Chicago in December, 1937, decided that immediate steps should be taken to ensure the preservation of the existing open pollinated varieties, as it was obvious that the germ plasm of these varieties had not been sampled adequately. Mention was made also of several varieties that had already gone out of cultivation as a direct result of hybrid competition.

Sources of Hybrid Seed.

As the double crossed seed released to farmers for commercial sowing produces the F_1 generation of a cross between two single crosses, it is essential that the grain produced by commercial crops should not be used for seed purposes, as in later generations it will decline considerably in yielding ability and uniformity. It is essential therefore that the grower secures fresh stocks of hybrid seed for planting each season. This has resulted in a tremendous development of the maize seed trade and has rendered necessary a great deal of extension work amongst farmers, as the general policy with open pollinated varieties was to encourage growers to select their own seed.

The two main sources of hybrid seed are firstly, the large commercial seed companies who employ specially trained staffs of plant breeders and agronomists to control their seed production programmes, and secondly, private farmers who, under close supervision, produce hybrid seed from breeding stocks purchased from the agricultural experiment stations.

Breeding stocks purchased from the experiment stations must be ordered 14 months in advance of delivery so that the station can plan its planting programme according to demand. Orders must be accompanied by a deposit, and commonly this deposit is regarded as an option and is not refundable under any circumstance.

The breeding stocks obtainable from the experiment stations may consist of inbred lines or foundation hybrids (single crosses for use in production of double crosses). The Wisconsin Agricultural Experiment Station, however,

does not release its inbred lines as it is considered desirable to maintain complete control of the basic breeding material until the single crosses have been made. The production of single crosses for use as foundation hybrids is done under contract on selected farms within 50 miles of the Wisconsin Experiment Station and a very close supervision is exercised.

As might be expected, the price of hybrid seed has varied considerably in different years. Dowell and Jesness state that from 1934 to 1936 the price varied from 6 to 15 dollars a bushel. The range in 1937 was about $7\frac{1}{2}$ to 11 dollars, and in 1938 it was from 5 to 8 dollars a bushel. The view expressed to the writer by various experiment station workers was that the price would become stabilised at 5 to 6 dollars a bushel.

Certification of Hybrid Seed.

Each of the main maize producing States has enacted legislation controlling the sale of hybrid seed maize, and in most cases only certified seed can be sold. Seed certification is usually controlled by a State Seed Improvement Association or similar body which works in very close cooperation with the State Experiment Station. These associations have very strict requirements which must be met before certification is made and specific regulations have been framed to govern every aspect of hybrid maize seed production.

A brief outline of the regulations of the Ohio Seed Improvement Association will indicate the type of control that is an essential part of the hybrid maize programme in the various States.

At the outset the aims and objectives of the Association are stated, and there is a clear definition of what constitutes an inbred line, single cross, foundation hybrid, commercial hybrid, double cross and three-way cross.

In all cases breeding stocks and commercial hybrids are eligible for certification only on the joint approval of the Agronomy Department of the Agricultural Experiment Station and the Board of Directors of the Seed Improvement Association. In the case of inbred lines approval is granted only when the certifying agency is satisfied that the control technique was adequate to guard against stray pollination in excess of 0·1 per cent., and where the lines are being increased by sib pollination they must be grown at least 40 rods distant from other maize.

Single crosses or foundation hybrids must be produced from certified inbreds or from inbreds supplied by the experiment station. The cross must be effected by hand pollination or in an isolated crossing block distant 40 rods from other maize. Detasselling of the female parent must have been done sufficiently early and well to ensure that not more than 0·5 per cent. of its tassels shed pollen prior to removal.

Commercial hybrids, which are usually double crosses, but may be single or three-way crosses, must represent a specific combination of certified inbred lines, produced by hand pollination or in an isolated crossing block, in which not more than 1 per cent. of the female parent plants have shed pollen prior to detasselling. Daily detasselling is usually necessary to keep within this limit. The crossing field must be inspected by representatives of the certifying authorities at least twice during the period of pollination. More frequent inspections may be made and in no case need previous notice of inspection be given to the grower.

In all cases prior to certification the commercial hybrid must fulfil certain performance requirements in official tests conducted by the State Agricultural Experiment Station. It must be superior to the better open pollinated varieties in lodging resistance, it must yield at least 10 per cent. more grain and it must have a combined advantage in lodging resistance and grain yield of not less than 25 per cent. This performance requirement must have been achieved in one or more locations in each of two years within the five-year period immediately preceding certification, or in each of three well distributed counties in any one year of the same five-year period. The acceptable storage conditions for seed are defined, and where artificial drying to 14 per cent. moisture content by means of warm high velocity air has not been carried out, the seed must be stored on racks.

Seed of commercial hybrids must be bright in colour and uniformly graded. Its moisture content must not exceed 14 per cent. and it must have a minimum germination capacity of 90 per cent. No specific germination standards are set down for seed of inbred lines or foundation hybrids, but in all cases the germination capacity must be recorded on the tags affixed to the bags prior to sale. All certified seed bears the appropriate tag of the Association.

A fixed scale of inspection and certification charges is made by the Association. In 1937 the fees payable for certification in Ohio were 8 dollars per farm +2 dollars for each separate field+1 dollar for each of the first 20 acres in each field+50 cents for each acre over 20 in each field. The fee payable for certification of a two-acre crossing field was thus 12 dollars, for five acres it was 15 dollars, for 20 acres it was 30 dollars and for 40 acres 40 dollars. All applications for inspection must be received by a certain date and all fees are payable in advance at the same time.

The Ohio Seed Improvement Association is administered by a board of directors and a paid manager. The State University and the Agricultural Experiment Station each appoint one director, and five additional directors are elected by members of the Association on the basis of one representative for each of the four zones into which the State is divided and one director elected at large.

Artificial Drying of Seed Maize.

Coincidental with the rapid extension of hybrid maize there has been a marked increase in the practice of artificially drying maize that is to be used for seed purposes. Artificial drying was first used for sweet corn in Ohio about 1920, and subsequently, the Wisconsin Agricultural Experiment Station developed the bin driers upon which practically all the modern drying plants are based. The moisture content of the grain is reduced to 14 per cent. or slightly less by means of high velocity air heated to a temperature of 110° F. and circulated through the bins by means of a fan. A very satisfactory type of drier consists of two rows of bins with a common air duct between them. The main duct receives the heated air from the fan and connects by means of dampers with the top and bottom of each bin. The air is usually heated by a hot air furnace, and for driers having a capacity up to 4,000 bushels; the ordinary residence type of heating furnace is quite satisfactory. The direction of the air current through the bins is usually reversed every 6 or 12 hours, and effective drying is normally obtained within 72 hours.

Foliage Poisons for the Queensland Fruit Fly (*Strumeta tryoni* Froggatt)

THE REPELLENT EFFECT OF MOLASSES

By

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The first published recommendation for the use of foliage poison sprays for the control of fruit flies was made by Mally[4] of South Africa, who suggested a coarse " hit or miss " spray leaving small globules of an attractive substance containing poison on the leaves, and stated that the Mediterranean fruit fly, *Ceratitis capitata* Wied., succumbed readily to treacle containing an arsenical poison. Although treacle was included in his recommendations, his field tests published later in 1909 were conducted with a cheap brown sugar.[5]

Berlese[2] at the same time was also experimenting with foliage poison sprays for the control of the Olive fruit fly, *Dacus oleæ* Rossi, and the attractant medium used was a mixture containing molasses 2 parts, honey 1 part, and a small quantity of glycerine.

Following the investigations of these two workers, experiments with foliage poison sprays have been carried out in various parts of the world against many species of fruit flies. Molasses has been in fairly general use for a number of reasons, including cheapness, small attraction for bees, and finally the viscous nature of the deposit remaining on the foliage.

In 1934, Ripley and Hepburn[9] came to the conclusion that treacle (also called molasses by these authors) and brown treacle sugars should not be substituted for white sugar in any formulæ which also included fluosilicates or arsenates. It had been previously demonstrated that various fluorine insecticides lose much of their toxicity in the presence of certain lime compounds which react with them to form relatively insoluble and non-toxic calcium fluoride.

Newman and Jenkins,[8] working in Western Australia, confirmed these conclusions and later Wright[10] obtained somewhat similar results in New South Wales. In both States a sodium fluosilicate-white sugar foliage poison bait is now recommended.

In considering the foregoing findings it is evident that the apparently lower toxicity of the molasses-sodium fluosilicate mixture, when compared with sodium fluosilicate-white sugar, is not unexpected. However, the reverse might be expected with the lead arsenate-molasses mixture in which chemical reactions would be likely to result in the formation of more toxic arsenical compounds.

During the past season the results of toxicity tests that have been carried out with the Queensland fruit fly strongly confirmed the opinion that molasses was an unsuitable material to use in foliage poison sprays. When flies were held in cages and fed with unpoisoned molasses or sugar it quickly became evident that they would feed on sugar or sugar solutions in preference to

molasses. In view of this preference and of the probable repellence of molasses, a number of tests were carried out to determine whether or not molasses was a suitable fly food to use in foliage poison sprays.

Comparative Feeding on Sugar and Molasses Mixtures.

Toxicity tests were carried out in small wooden cages which have been found suitable for breeding the Queensland fly.[1] The foliage poison spray to be tested was measured and applied to the glass top and allowed to dry. The spread of the material was limited to a circle of approximately 3-inch diameter which was drawn with a grease pencil on the glass. In comparative tests of sugar or molasses mixtures two such circles of approximately 2-inch diameter were used on each glass top and the various mixtures applied and allowed to dry as in the toxicity tests.

Sugar was used at the rate of 2½ lb. to 4 gals. and molasses at the rate of 4 lb. to 4 gals., although the proportions should not be of any importance, for in this test, as in the field, the foliage poison spray dries out, leaving concentrates of sugar or molasses.

Figure 1.
Queensland Fruit Flies feeding on white sugar in preference to molasses.

Figure 1 illustrates the consistent and exclusive preference of Queensland fruit flies for cane sugar over molasses. The general insistence on the desirability of a viscous or hygroscopic bait did not seem to hold under the conditions of these tests.

In a second series of experiments, the following mixtures were tested in pairs, every material being tried against each of the others :

(1) Sugar 2½ lb. to 4 gals. water.
(2) ,, 2½ lb., apple syrup 1 gal., water 3 gals.
(3) Molasses 4 lb. to 4 gals. water.
(4) ,, 4 lb., apple syrup 1 gal., water 3 gals.

The apple syrup was prepared in accordance with the usual recommendation, e.g. boiling 5 lb. of fruit in sufficient water to give 1 gal. of liquid. This syrup was considered to make the molasses more attractive to fruit flies.

Twenty flies were placed in each cage and counts were made at half-hourly intervals from 9 a.m. to 5 p.m. of the number of flies feeding at the various mixtures. These periodical counts were continued during the first three days of the test, discontinued for three days, and then resumed on the final three days of the experiment. The feeding records are given in Tables 1 and 2.

TABLE 1.—*Daily Records of Feeding of Queensland Fruit Flies on various Sugar or Molasses Mixtures.*

Date.	Number of Flies observed Feeding.											
	Cage No. 1.		Cage No. 2.		Cage No. 3.		Cage No. 4.		Cage No. 5.		Cage No. 6.	
	Molasses.	Sugar.	Molasses and Fruit Syrup.	Sugar.	Molasses and Fruit Syrup.	Sugar and Fruit Syrup.	Sugar.	Sugar and Fruit Syrup.	Molasses.	Sugar and Fruit Syrup.	Molasses.	Molasses and Fruit Syrup.
1/5/40	—	23	—	27	—	17	22	11	—	13	—	—
2/5/40	—	14	—	15	—	9	9	6	—	17	—	5
3 5/40	—	32	—	24	—	11	9	7	—	23	—	3
6/5/40	—	30	1	32	—	29	17	15	—	24	—	15
7/5/40	—	22	—	25	—	13	15	14	—	24	2	21
8 5/40	—	18	—	24	—	10	6	9	—	16	1	16
Totals	—	139	1	147	—	89	78	62	—	117	3	60

TABLE 2.—*Summary of Data on the Feeding of Queensland Fruit Flies on Sugar or Molasses Mixtures.* (Cf. Table 1.)

Material.	Number of Flies Observed Feeding.
1. Sugar	364
2. Sugar plus fruit syrup	268
3. Molasses	3
4. Molasses plus fruit syrup	61

These results again show a clear preference by Queensland fruit flies for cane sugar over molasses. Where a choice is possible, the molasses is entirely neglected and must therefore exercise a pronounced repellent effect on fruit flies in search of food.

The addition of apple syrup did not make the sugar any more attractive to the flies, but it did render the molasses more attractive, apparently masking some of the repellent properties. Where the flies were compelled to feed on molasses, either alone or mixed with apple syrup, no feeding was observed on the first day, and little feeding later until the flies were compelled to feed or starve.

Figure 2.
Molasses deposit (upper) untouched, while the white sugar has been fed on extensively.

Figure 3.
Showing more extensive feeding on the molasses-fruit syrup deposit (upper) than the molasses deposit (lower).

Figure 2 illustrates the nature of the feeding which took place in cage No. 1; the untouched deposit of molasses and absence of molasses-coloured excrement show that feeding did not take place at periods other than those observed.

Figure 3 indicates that a mixture of molasses and apple syrup is more attractive than molasses alone, and the feeding marks and molasses-coloured excrements show that extensive feeding took place under the compelling influence of hunger.

Toxicity of Sodium Fluosilicate with Sugar, Molasses or Hydrated Lime.

The reluctance of flies to feed on molasses was considered to offer one explanation for the apparent loss in toxicity of both sodium fluosilicate and

lead arsenate which has been discussed earlier. Accordingly a feeding test was arranged, using sodium fluosilicate as the insecticide, with the object of ascertaining whether this presumed lowered toxicity was due to the repellence of molasses or to the presence of a lime salt in molasses which would result in the formation of a relatively non-toxic salt.

The following sprays were tested:

(1) Sodium fluosilicate 2 oz., white sugar 2½ lb., water 4 gals.

(2) Sodium fluosilicate 2 oz., white sugar 2½ lb., hydrated lime 1 lb., water 4 gals.

(3) Sodium fluosilicate 2 oz., molasses 4 lb., water 4 gals.

(4) Control: sugar 2½ lb., water 4 gals.

The results are set out in Table 3.

TABLE 3.—*Toxicity of various Sodium Fluosilicate Baits Fed to Queensland Fruit Flies.*

Treatment.	Progressive Mortality of Flies after—										No. Flies Tested.
	1 day.	2 days.	3 days.	4 days.	5 days.	6 days.	7 days.	8 days.	9 days.	10 days.	
1. Sodium fluosilicate+sugar	2	14	27	36	43	47	50	51	51	51	59
2. Sodium fluosilicate+sugar+hydrated lime	1	1	1	1	1	1	1	1	1	1	61
3. Sodium fluosilicate+molasses..	—	—	—	1	2	2	2	2	2	2	60
4. Control: sugar ..	—	—	—	—	—	—	—	—	—	—	63

Hydrated lime and molasses were equally effective in bringing about the virtual immunity of the flies to poisoning. Because of the repellent action of the molasses it is not clear whether the lack of poisoning of the flies was due to this factor or to the actual loss of toxicity of sodium fluosilicate possible in the presence of the lime salt in the molasses.

The number of flies feeding on the various mixtures was observed at intervals of approximately half an hour on the first day of the test. The feeding records are set out in Table 4.

TABLE 4.—*Number of Queensland Fruit Flies observed Feeding on various Baits.* (Cf. Table 3.)

Material.	Number of Flies Observed Feeding.
1. Sodium fluosilicate+sugar	43
2. Sodium fluosilicate+sugar+hydrated lime	43
3. Sodium fluosilicate+molasses	3
4. Control: Sugar	59

The records indicate clearly that molasses is not acceptable to Queensland fruit flies and, further, that some degree of repellence may be exerted by sodium fluosilicate.

Toxicity of Tartar Emetic with Sugar or Molasses.

In view of the fact that molasses has been known to impair the efficiency of baits containing lead arsenate and sodium fluosilicate, both these poisons having been proved definitely inferior to tartar emetic, the question of the reaction of tartar emetic to molasses was raised. Tartar emetic has been used with molasses and found effective for the control of the West Indian fruit fly[6][7] and for the citrus thrips,[3] and it would therefore appear that no injurious chemical reaction takes place likely to render the tartar emetic non-poisonous.

TABLE 5.—*Toxicity of Tartar Emetic Baits Fed to Queensland Fruit Flies.*

Treatment.	No. of Tests.	Progressive Mortality of Flies after—						Flies Alive.	Total No. Flies.
		1 day.	2 days.	3 days.	4 days.	5 days.	6 days.		
(*a*) *Enforced Feeding:*									
1. Tartar emetic+ sugar	5	35	**108***	140	152	155	157	—	157
2. Tartar emetic+ molasses ..	2	—	2	2	4	5	15	32	47
3. Check: molasses	2	—	—	—	—	1	1	46	47
(*b*) *Alternative Food Supply (Sugar):*									
1. Tartar emetic+ sugar	2	12	**25**	27	27	28	28	12	40
2. Tartar emetic+ molasses ..	2	1	1	1	2	2	2	39	41
3. Check: molasses	2	—	—	—	—	—	—	25	25

* Figures in bold type represent first record of mortality of 50 per cent.

The results set out in Table 5 prove that molasses when mixed with tartar emetic markedly reduces the efficiency of this poison for Queensland fruit fly when compared with tartar emetic-sugar mixture. As molasses and tartar emetic have been found effective against another species of fruit fly, it does not seem likely that the explanation of this lowering of toxicity is purely chemical. Further, in the case of enforced feeding a considerable mortality was obtained by the end of six days, whereas in the case of an alternative sugar supply being available the mortality was negligible, again indicating that repellence and not lack of toxicity was responsible for the results.

It is of interest to record that a 50 per cent. mortality occurred on the second day with both tartar emetic-sugar baits. The fact that enforced feeding did not produce a quicker kill than where an alternative food supply was available indicates that tartar emetic is not repellent.

Summary.

Molasses was included in the earliest foliage poison sprays tested and has been in general use during the past thirty years against many species of fruit flies.

Laboratory feeding tests have shown that Queensland fruit flies will not feed upon undiluted molasses, unless forced to do so by actual starvation. The addition of apple syrup renders molasses more palatable to the flies, but not to the extent that they will feed on this mixture if white sugar is available.

The addition of hydrated lime to the sodium fluosilicate-sugar bait renders it as ineffective as the sodium fluosilicate-molasses bait. Feeding records indicate that the sodium fluosilicate may be slightly repellent, but that molasses is definitely repellent.

Tartar emetic, a poison which has been proved to be considerably more effective against Queensland fruit fly than either lead arsenate or sodium fluosilicate, must also be included with these two poisons as becoming relatively ineffective in the presence of molasses. Owing to experience abroad with other species of fly, and to the rather higher order of toxicity obtained under conditions of enforced feeding, it would appear that the loss in efficiency of the bait in this instance is due to the repellence of molasses.

As molasses has been shown to lower the efficiency of the two commonly used foliage poison spray insecticides—lead arsenate and sodium fluosilicate—and the more effective laboratory tested tartar emetic, the use of molasses in foliage poison sprays should be discontinued.

Feeding tests have shown that the Queensland fruit flies do not find molasses an attractive food compared with sugar, and although they will ultimately feed and live for considerable periods on molasses, they do so under the compulsion of starvation as the alternative. White sugar is an important constituent of some of the naturally occurring foods available to fruit flies, e.g. nectar and honey dew, and consequently its suitability as a medium for conveying an insecticide is not surprising.

Experiments with other naturally occurring sugars, especially those of a viscous nature found in fruit juices, would appear to offer the most likely means of improving the present white sugar foliage poison baits.

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TECHNICAL NOTES

A FACTOR INFLUENCING ABUNDANCE OF THE APPLE LEAF-HOPPER (*TYPHLOCYBA FROGGATTI* BAKER).

The apple leaf-hopper is an insect of European origin that now occurs in all States of eastern Australia, with the possible exception of Queensland. It has two complete generations a year, the eggs of one generation being laid in the veins and mid-ribs of leaves, and those of the other under the bark of wood.

The insect is of considerable economic importance, as the feeding activities of the nymphs cause the yellowing and early dropping of leaves, whilst the excrement of the adult insects on fruit necessitates the wiping of apples to render them fit for export.

In New Zealand, where it is also established, it is controlled to some extent by an egg-parasite (*Anagrus armatus* Ashm.) and Dumbleton,[1] in a discussion of the effect of the parasite, states that " the leaf-hopper population appears to remain fairly steady at a relatively low level from year to year ".

A. armatus was introduced into Tasmania from New Zealand five years ago, and has been successfully established. The observations that follow were made during the course of the work connected with the building up of parasite material for general distribution.

In one of the orchards in which the parasite was placed, it was found that in the season following liberation the numbers of over-wintering eggs present were very low compared with those of the preceding season. As the parasite could not possibly have been responsible for such a reduction in so short a time, another explanation was sought. In neither season had nicotine-sulphate sprays been applied, and there had been no evident change in actual leaf-hopper abundance.

The only factor, apart from weather, not common to the two seasons, was that in the second the orchard was neglected, being neither pruned nor ploughed.

It has been recorded in the United States that the white apple leaf-hopper (*Typhlocyba pomaria* McAtee) is generally very much more abundant in sprayed than in neglected orchards,[2] and Steiner[3] offers the opinion that the explanation lies in the fact that certain orchard practices reduce the effectiveness of its natural enemies. The same difference between well-kept and neglected orchards has been noticed in Tasmania, and it is suggested that the reason is due to the effect orchard practices, other than spraying, have on the growth of the trees. The majority, though not quite all, of the over-wintering eggs, are laid in wood of the current season's growth, and if trees are not pruned it may happen that not only is little new wood produced in the ensuing season, but that growth ceases early. The bark of such wood may well be impervious to the ovipositor of the leaf-hopper, which is only able to penetrate that of succulent, vigorously growing shoots.

At the end of the season following the winter when the trees in question had not been pruned, six shoots, each of two years' growth were removed, the growth for the two years measured, and the eggs and egg-scars counted. The results obtained are set out in the accompanying table.

Relative Abundance of Eggs of Typhlocyba froggatti *in Apple Shoots.*

Growth of Shoots in Inches.		No. Eggs Laid.	
1936–37.	1937–38.	1936–37.	1937–38.
30	12	154	1
20	12	272	1
24	11	223	4
22	9	197	1
24	10	202	2
20	7	119	2

It is possible that the association of *T. froggatti* with apple and hawthorn trees is correlated with the ease with which eggs may be laid in the wood of these trees, as it has been determined by experiment and observation that the insects will readily feed on several other plants belonging to the Rosaceæ.

Nymphs have been reared in the laboratory on pear, cherry and plum leaves, and have been seen in the field on pear, plum, roses and ornamental *Cratægus* spp. The association with these plants is induced by overcrowding on an adjacent preferred food-plant (apple or hawthorn), and is seldom maintained in successive seasons.

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MOLYBDENUM AS AN ESSENTIAL ELEMENT FOR PLANT GROWTH.

In recent years, as the result of improvements in the technique of water cultures and in the purification of the reagents used, the list of elements necessary for plant growth has been extended. Molybdenum is the latest element to be added. In 1938, Arnon[1] obtained considerable increases in the yield of asparagus and lettuce when grown in water cultures to which a group of seven elements (Mo, Ti, V, Cr, W, Co, Ni) had been added, and last year, in collaboration with Stout,[2] he was able to show that this increase was due to molybdenum. Tomatoes grown in a nutrient solution in the absence of molybdenum developed a peculiar mottling and necrosis of the leaves whereas those grown in its presence made healthy growth.

The essential nature of molybdenum for the normal growth of oats has been confirmed at the Waite Institute during the course of last season's water culture investigations on the influence of copper on plant growth. Oats were grown in a nutrient solution of the following composition:

Potassium nitrate	1·0 grm. per litre
Potassium dihydrogen phosphate	0·5 „ „ „
Calcium sulphate	0·5 „ „ „
Magnesium sulphate	0·5 „ „ „
Sodium chloride	0·1 „ „ „
Ferric citrate	0·02 „ „ „

Manganese, zinc, boron and copper were also included, at concentrations of 1·0 mg., 0·2 mg., 0·1 mg. and 0·1 mg.* per litre, respectively. Each of the major constituents of the nutrient solution was purified separately. The general method of purification consisted in the co-precipitation of the heavy metals as phosphates, along with calcium phosphate, at a reaction of about pH 8, followed by repeated extraction with a solution of dithizone in carbon tetrachloride. The purified salt was then obtained by crystallisation. Potassium acid phosphate was prepared by crystallisation from a solution of potassium phosphate, purified as above, and glass-distilled nitric acid. Calcium sulphate was precipitated by the addition of redistilled sulphuric acid to a solution of purified calcium chloride and the ferric citrate was obtained from recrystallised citric acid and ferric chloride, the latter having been purified by the ether extraction method. All water used, both for the preparation of the reagents and for the water cultures, was redistilled from pyrex glass stills with a capacity of 1 to 1·5 litres per hour and designed for continuous operation.

In preliminary water culture experiments with oats in 1938, grain formation had not been good and it was suspected that a deficiency of some minor element, other than manganese, boron, zinc and copper, existed. Traces of molybdenum were therefore included in certain jars in two series of water cultures in 1939, and Table 1 shows the influence of this element on the yields obtained. The plants used were Algerian oats and the concentrations of molybdenum were 0·02 and 0·10 mg. per litre. Sodium molybdate was used as the source of molybdenum.

The oats were germinated on 11th May, 1939, and transferred to nutrient solutions as soon as they were large enough to handle. The nutrient solutions were renewed twice during the growing season.

For the first 20 weeks, all plants made normal healthy growth and no differences could be detected between plants with and without molybdenum. However, about the time of the emergence of the panicles, necrotic areas appeared on the upper leaves of those plants which were not receiving molybdenum. These necrotic areas usually commenced about midway along the leaf blade and frequently extended across the whole width of the blade. At first the leaves bent backwards in a sharp but smooth bend, but later a kink

* In the first experiment reported in Table 1 the concentration of copper varied from 0·02 mg. to 2·0 mg. per litre.

developed at the collapsed area and the mid-portion of the leaf dried out to a light reddish-brown colour. About this time, the final change of nutrient solution was made and although no further leaf symptoms developed there was a considerable difference in grain formation. Panicles developed normally in all jars but in the presence of molybdenum the grain filled out and ripened normally, whereas in those jars from which molybdenum was excluded the grain consisted entirely of empty husks. This difference is clearly reflected in the grain yields given in Table 1.

Although the results of this investigation show that traces of molybdenum are necessary for grain formation, it is probable that the use of reagents of

TABLE 1.—*The Effect of Molybdenum on the Yield of Algerian Oats in Water Cultures.*

	Total Yield.			Grain Yield.		
	With Mo.	Without Mo.	S.E.	With Mo.	Without Mo.	S.E.
	g.	g.		g.	g.	
Series A*—						
(Mean of 7 jars)	145·8	128·8	6·5	35·8	11·9	2·7
Series B†—						
Mean of 23 jars	150·3		5·4	37·1		1·4
Mean of 9 jars		144·5			14·2	

* Series A was from an experiment with increasing copper concentration, and represented all jars from 0·02 mg. Cu to 2·0 mg. Cu per litre. Molybdenum, when added, was present at the rate of 0·02 mg. per litre.

† Series B represented jars from another experiment having 0·1 mg. of Cu per litre. Twenty-three of these jars contained 0·1 mg. of Mo per litre while 9 jars were free from molybdenum.

higher purity will show even greater differences in total growth. The method used for the purification of the reagents was designed primarily to eliminate traces of copper and other heavy metals. Molybdenum is not extracted by dithizone, nor is it precipitated from alkaline solutions along with the phosphates of the other heavy metals, so that such purification as has been obtained has occurred during the recrystallisation. By the use of more appropriate methods of purification it should be possible to reduce still further the remaining traces of molybdenum. A high degree of purification is essential since 0·02 mg. of molybdenum per litre of nutrient solution is more than sufficient for normal growth. Investigations with more highly purified reagents are at present in progress.

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The Australian Institute of Agricultural Science

THIRD GENERAL MEETING

The third General Meeting will be held in the School of Agriculture, Melbourne University, on 4th November, 1940, at 2 p.m. Business will include Report of Council, Statement of Accounts and Balance Sheet, Election of President, Reports on Institute Projects (Plant Quarantine, Potentialities Survey, Status and Salary Survey), and Notice of Motion to amend Articles of Association (Para. 4 of Clause 4).

On the evening of the General Meeting the Victorian Branch will hold a dinner, after which the Presidential Address will be given.

MEETINGS OF COUNCIL.

May Meeting.

Held in the School of Agriculture, Melbourne University, on 23rd May, at 8 p.m. *Present :* Mr. F. M. Read (V.) (in chair), Dr. A. E. V. Richardson (S.A.), Dr. H. C. Forster (W.A.), Mr. G. W. Leeper (A.C.T.), Mr. H. J. Geddes (T.), the Honorary Treasurer, Mr. R. L. Twentyman, the Honorary Secretary, Mr. A. J. Vasey, and the Assistant Honorary Secretary, Mr. R. D. Croll. Apologies were received from Mr. J. L. Gillespie (N.S.W.) and Mr. P. S. Lang (Q.).

The following applicants were admitted to corporate membership : K. H. Key (A.C.T.), N. H. Shaw (A.C.T.), D. A. C. Cameron (A.C.T.), W. Hartley (A.C.T.), J. McC. McCann (Vic.).

The financial statement disclosed a balance at bank of £134 5s. 2d.

Mr. Read (V.) presented the views of the Committee of the Victorian Branch regarding the size of the Journal. It was thought that Journal expenditure should not be increased at the present time. The Victorian Branch considered that the net expenditure of the Journal for this year should not exceed the net expenditure in 1939. If the question of curtailing the material published should arise, addresses and articles on general topics should be excluded before Branch reports and technical articles.

The following is a summary of the position *re* Institute membership as at 31st December, 1939 :

Branch.	Membership at 31/12/38.	Admissions and Transfers.	Resignations and Transfers.	Membership at 31/12/39.	Financial.	Unfinancial.	Student Members.
New South Wales ..	96	16	5	107	91	16	14
Victoria	98	17	5	110	96	14	3
South Australia	55	6	2	59	53	6	6
Queensland	51	5	3	53	44	9	2
Western Australia ..	44	11	4	51	41	10	8
Australian Capital Territory	30	6	2	34	28	6	—
Tasmania	17	1	1	17	15	2	—
Overseas	1	—	1	—	—	—	—
	392	62	23	431	368	63	33

July Meeting.

Held in Department of Agriculture, Melbourne, on 4th July, at 5.20 p.m. *Present :* Mr. F. M. Read (V.) (in chair), Dr. A. E. V. Richardson (S.A.), Dr. H. C. Forster (W.A.),

THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE.

Income and Expenditure Account for Year ended 31st December, 1939.

1938 £ s. d.	EXPENDITURE.	1939 £ s. d.	£ s. d.
140 18 8	To Cost of Journal		152 17 8
38 12 3	,, Printing and Stationery		56 6 3
—	,, Annual Meeting Expenses		29 18 3
55 15 6	,, Incorporation Expenses		—
3 5 9	,, Incidentals		1 16 0
8 8 0	,, Audit and Accountancy Fees		8 8 0
10 16 7	,, Petty Cash		6 16 6
—	,, Survey Maps		4 7 0
	,, Grants to Branches—		
25 0 6	New South Wales	28 12 0	
28 17 6	Victoria	27 10 0	
14 6 0	South Australia	15 13 6	
12 7 6	Queensland	13 9 6	
13 4 0	Western Australia	12 7 6	
7 14 0	Australian Capital Territory	7 19 6	
5 10 0	Tasmania	4 2 6	
			109 14 6
£364 16 3	,, Total Expenditure		£370 4 2
52 19 9	,, Surplus for Year		63 19 10
£417 16 0			£434 4 0

1938 £ s. d.	INCOME.	1939 £ s. d.	£ s. d.
	By New South Wales Branch, Subscriptions—		
6 6 0	Arrears	13 13 0	
90 0 0	Current	99 1 0	
			112 14 0
	,, Victorian Branch, Subscriptions—		
11 11 0	Arrears	4 4 0	
98 19 0	Current	101 11 0	
			105 15 0
	,, South Australian Branch, Subscriptions—		
3 3 0	Arrears	4 9 0	
52 4 0	Current	57 3 0	
			61 12 0
	,, Queensland Branch, Subscriptions—		
2 2 0	Arrears	5 10 0	
45 18 0	Current	46 14 0	
			52 4 0
	,, Western Australian Branch, Subscriptions—		
6 6 0	Arrears	4 14 0	
45 12 0	Current	45 1 0	
			49 15 0
	,, Australian Capital Territory Branch, Subscriptions—		
—	Arrears	1 1 0	
29 8 0	Current	29 8 0	
			30 9 0
	,, Tasmanian Branch, Subscriptions—		
3 3 0	Arrears	—	
17 17 0	Current	15 15 0	
			15 15 0
1 11 0	,, Overseas Subscriptions		6 0 0
3 16 0	,, Interest		
£417 16 0			£434 4 0

Balance Sheet as at 31st December, 1939.

1938 £ s. d.	LIABILITIES.	1939 £ s. d.	£ s. d.
	Sundry Creditors—		
123 4 0	Branch Grants	117 19 6	
21 3 3	General	9 15 3	
			127 14 9
4 4 0	Subscriptions Paid in Advance		3 3 0
250 12 3	Accumulated Fund—Balance at 1/1/1939	303 12 0	
52 19 9	*Add* Surplus for Year to 31/12/1939	63 19 10	
			367 11 10
£452 3 3			£498 9 7

1938 £ s. d.	ASSETS.	1939 £ s. d.	£ s. d.
6 10 0	Office Furniture—Sydney		9 5 0
	Cash at Bank—		
187 5 8	Melbourne	194 8 5	
17 3 7	Sydney	28 14 2	
			223 2 7
200 0 0	Fixed Deposits	200 0 0	
2 5 0	Fixed Deposits Accrued Interest	8 5 0	
			208 5 0
37 10 0	Subscriptions Outstanding (since collected)		54 1 0
1 9 0	Petty Cash on Hand		3 16 0
£452 3 3			£498 9 7

These are the Statements referred to in our report dated 23rd May, 1940.

(Sgd.) CLEVELAND, SON & HISLOP,
Chartered Accountants (Aust.).

Mr. G. W. Leeper (A.C.T.), Mr. H. J. Geddes (T.), Mr. J. L. Gillespie (N.S.W.), the Honorary Secretary, Mr. A. J. Vasey, and the Assistant Honorary Secretary, Mr. R. D. Croll.

Apologies were received from the Honorary Treasurer, Mr. R. L. Twentyman, and Mr. P. S. Lang (Q.).

The following applicants were admitted to membership:

To Corporate Membership: G. Blackburn (Vic.), A. J. K. Walker (S.A.), S. M. Sykes (N.S.W.), N. C. Lloyd (N.S.W.), E. S. Clayton (N.S.W.), E. Ashby (N.S.W.), A. H. E. McDonald (N.S.W.), M. C. Franklin (N.S.W.), D. A. Gill (N.S.W.), H. B. Carter (N.S.W.), A. G. Lowndes (N.S.W.).

To Student Membership: R. G. Beck (S.A.), L. C. Birch (S.A.), P. F. Butler (S.A.), P. J. Young (S.A.).

As Professor Prescott had been nominated by the Victorian, South Australian and Queensland Branches for the Presidency of the Institute for the forthcoming year, the Secretary was directed to write to Professor Prescott asking him if he would accept nomination as President.

The fiancial statement showed a balance at bank of £93 14s. 3d.

In view of the indefinite postponement of the A. and N.Z.A.A.S. meeting in Adelaide, it would appear undesirable to proceed with the Institute general meeting, arranged for Adelaide in August. However, under the terms of Article 49 such a meeting must be held prior to 31st December, 1940.

The W.A. Branch has expressed its approval of the recent election of veterinary science graduates to membership of the Institute. The Branch feels that closer association between these interests would be beneficial and raises the question as to what reciprocity the Veterinary Institute will concede to a graduate in agriculture. It was decided to ascertain Branch opinions as to a course of action in this matter.

MEETINGS OF BRANCHES.

Victorian Branch.

The Branch is co-operating with the Australian Institute of International Affairs in a national research project on "Australia, the War and the Peace". The aim is to compile a comprehensive chronology of the war as it affects Australia and to furnish a running commentary and interpretation of current changes. The sections being undertaken by the Melbourne group of the A.I.I.A. include a review of Australian production, industry and politics during the war period. The Victorian Branch of the A.I.A.S. is collaborating in the studies concerning the primary industries and some 14 members, under the chairmanship of Professor S. M. Wadham, have each been allotted a sub-section of the survey. These members are regularly collecting data and preparing reviews on various crops, live stock and farm products. They meet monthly and discuss the current agricultural position. Mr. W. D. Forsyth, Research Officer of the A.I.I.A., is in general charge of the project and files the various reports. These are available for perusal.

The report on Soil Erosion Control in Victoria, prepared conjointly by the Institutes of Surveyors, Engineers, Foresters and Agricultural Science, was presented on 24th May to a Sub-Committee of Cabinet appointed to examine this problem.

The report of the Plant Quarantine Sub-Committee has been completed and forwarded to the Central Committee.

Members attended the following meetings of the M.U.Ag.Sc.:

On 17th May Professor Wadham spoke on his "Impressions of Danish Agriculture". The soils in Denmark, he said, ranged from sandy types, on which grass and clover hay, corn and rye were the most common crops, to heavy soil types which grew mainly wheat and root crops. The Danes were attempting to reclaim some of their heath country which had an extremely high acid content (pH 3·5) by breaking up the humus pan with a subsoil

plough, liming and planting potatoes. An interesting feature was the remarkable efficiency of Danish dairy farming and the high quality and vast quantity of dairy produce exported. The markets in Denmark were controlled by a quota system. Nothing was allowed to go to waste ; all drainage from the farm yard was stored in pits and scattered from the drills at seeding time. (Attendance 70.)

Mr. J. M. Ward addressed the Society on 21st June. His address was on " Australian Apples and Pears in the United Kingdom, and Fruit Growing Abroad ". With the aid of motion picture films Mr. Ward described the supervision of fruit in Victoria and the inspection of fruit prior to export, and in his opinion deterioration in quality of Australian fruit occurred during the voyage or during discharge in England. The problems of transport, packing and refrigeration necessitated further research, said Mr. Ward. The rough handling of cases at many of the unloading ports was severely criticised. The speaker then went on to describe the methods of marketing in England and the fruit growing industry in Holland, Germany, the United States and Canada. (Attendance 40.)

Mr. J. E. Harrison, Advisory Officer for the Australian Estates Co. Ltd., formerly an agrostologist with the State Department, gave an interesting address to the Society on 12th July. The title was " Pasture Improvement in the Apsley District ". Apsley is situated in the extreme west of Victoria and about 80 miles from the coast. The soil is a light to medium loam over a clay subsoil and the rainfall about 23 inches. About 1920, the district was subdivided as a closer settlement scheme but very little progress was made until a system of pasture improvement was introduced. Since then rapid strides have been made. Pasture improvement at Apsley consists principally of sowing 2 to 3 lb. subterranean clover per acre and topdressing annually with about 120 to 140 lb. superphosphate. From a survey of 16 farms (16,000 acres) in the district, it was ascertained that, before improved pastures were introduced, this area was carrying 8,000 to 9,000 sheep, i.e. 5 or 6 sheep to 10 acres. At the present time it is estimated that one-third of the area has been improved, one-sixth is being improved or in crop, while the balance (one-half) is still unimproved native pasture. In addition there are 24,000 sheep on the area (1½ per acre). It is estimated that the carrying capacity of the improved pastures is 2·83 sheep per acre. Wool yields have increased considerably also. Originally, sheep on native pastures produced 4 lb. wool per acre, while today, sheep on the improved pastures yield 28 lb. per acre. There was also an interesting comparison between the Merino properties which comprised about half the area, and those carrying Corriedales and Crossbreds. There was relatively more unimproved land on the Merino properties, although the amounts of fully improved pastures were about the same. The proportion of dry sheep carried was much higher on the Corriedale and Crossbred properties, and this was considered to be due mainly to the fact that these breeds were concerned largely with the production of fat lambs. The wool yield was also slightly in favour of the Corriedales and Crossbreds and in addition the owners of these breeds generally seemed to have more sheep for sale. Mr. Harrison considered that there was no reason why all paddocks, with the exception of the one around the wool shed, should not be fully improved.

South Australian Branch.

A meeting of the Branch was held on 27th June at which two addresses were given on the general subject of " Some Impressions of Conservation in American Agriculture ". Mr. J. K. Taylor dealt with the human factor in conservation, particularly from the farmer's viewpoint, and the necessity which drove the U.S. Government to active remedial measures in the past ten years. Various aspects of the New Deal policy were explained, such as loans to farmers, checking the drift to tenancy, payment for reduction of crop area to avoid gluts on the market, and the conservation programme sponsored by the Soil Conservation Service. The growing value of land and social planning programmes by community, county, State and Federal organisations was emphasised as a bright feature

of rural progress. While recognising that the lavish expenditure of public money could not continue for long, and that a proportion of the beneficiaries had profited unduly, it was thought that much good had come from the New Deal experiment in agriculture.

Dr. H. C. Trumble gave a running account of some of the territory he covered last year in the inter-range and south-western areas of U.S.A., illustrating types of country and the work being done by the Soil Conservation Service and Range Research section with an extensive series of coloured lantern slides. Some of the most promising work seemed to be located in the Utah and Californian range country dealing with forest and range grazing management.

Queensland Branch.

At the 29th ordinary meeting, held on 31st May, the investigations centred at the Nambour Field Station of the Department of Agriculture and Stock, under the control of the Horticultural and Entomological Sections of the Division of Plant Industry (Research) were described and discussed. Mr. W. A. T. Summerville dealt with the horticultural research. Work on French beans is concerned with fertilisers and minor elements and also with fertiliser placement. Macadamia (Australian or Queensland nut) investigations have aimed at eliminating the existing great variation in characters such as thickness of shell, amount of fruit borne on the peduncle, etc. The object is to secure horticultural varieties and to ensure their propagation. Single element fertiliser tests with passion vines have revealed useful information. Nitrogen in the form of sulphate of ammonia increases the growth of vine and fruit set, but in the absence of potash the fruit becomes bullet-like and useless. Field trials for varietal and stock-scion tests of the avocado, pineapple plant selection, and close observations on varieties and strains of the pawpaw have also been given considerable attention. Irrigation and plant growth are being studied in the case of citrus, while complete growth records of a large number of banana plants are also being kept.

Mr. N. E. H. Caldwell outlined entomological work of the past few years. The problem of banana rust thrips was studied and control measures elaborated. These were (*a*) dusting the bunch with nicotine dust at intervals or (*b*) covering the bunch with a bag and dusting less frequently. Recent work has concentrated on providing a more economical bag. A double brown-paper cover has proved promising. The problem of bronze bug of citrus has lately been reopened owing to the likelihood of shortage of oil for the resin-caustic soda-fish oil spray, and an attempt is being made to determine the efficiency of derris. Fruit fly bait sprays are being tested and an attempt is being made to develop a more efficient lure. Strawberry thrips and red spider are under investigation and the nicotine sulphate plus white oil spray for bean fly control has been tested and adopted for Queensland. A special pot technique has been developed for testing dusts and sprays for bean fly control.

The 30th general meeting, held on 29th June, comprised the first half of a symposium on plant improvement. Mr. W. W. Bryan dealt with the subject of maize improvement. He surveyed the methods adopted in other parts of the world and then discussed in detail the work in progress at Lawes. About 900 double crosses have been made at Lawes and 100 of these retained. Double crosses are consistently better than open-pollinated types in Queensland tests, some by as much as 12 bushels per acre over a series of bad years. Crops yielding up to 112 bushels per acre have been secured here from double crosses. While the main object of maize improvement in Queensland is to increase yield, attention is being paid to root and stalk strength, husk cover, angle of ears, etc. Grain quality is not given much consideration since maize is regarded here as a carbohydrate food, but vitreous endosperm is selected in preference to starch endosperm because of its greater disease and insect resistance.

Mr. A. F. Bell, in dealing with sugar cane improvement, said that the problems of sugar cane breeding were agronomic rather than genetic, since nothing was known of the

genetics of the crop, and in addition, selfing beyond the first inbred generation yielded sterile progeny. The existing varieties were heterozygous and attempts to develop pure lines were of no use. The difficulties of sugar cane improvement therefore were those concerned with crossing, selection and testing. Viable pollen was produced only in the wet tropics ; the germination and propagation work was carried out in three centres in Queensland. Many trial marriages were carried out, the parents being selected on the basis of pollen viability as shown by the iodine test, and a general idea of the value of the progeny was obtained by growing the seedlings. A special technique had been developed to avoid pollination by outside varieties. This depended on maintaining the cut arrows (inflorescences) in pots containing a mixture of sulphurous and phosphoric acids. The pots were kept in open forest for isolation. More recently, wooden frames covered with cheese-cloth were used for enclosing the arrows and preventing contamination. The technique was possible as the flowering period was brief, normally only eight weeks. The mature seed was stripped and could be stored in an airtight tin with calcium chloride at 32-40° F. ; it would remain viable for a year. At one station, 10,000 seedlings were raised each year and planted in 1/40 acre plots. Selections from these averaged 1½% of the total. These were Brix tested and the best again planted. Visual selection, coupled with sugar and rind-hardness determinations, decreased the number to about 10% for further tests and the best were subjected to Latin square tests at an experiment station and thence to farm tests. The whole process took about five years from the time of cross pollination.

Western Australian Branch.

A general meeting held on 7th June was attended by twenty members to hear Mr. J. Gentilli of the University Department of Economics speak on " Mediterranean Agriculture with special reference to Spain ".

The Mediterranean region was first defined in 1808 by the botanist De Candolle, and is characterised by a botanical association called " macchia " including Ilex, Quercus and Pinus and a thick undergrowth of shrubs. The olive, orange, lemon and mandarin are also Mediterranean. A temperate-cold winter, usually wet, and a dry summer, result from an influence of the Atlantic Ocean just as the Indian Ocean influences the climate of the south-west of Western Australia. The wettest part of the Iberian Peninsula is on the west, while the centre and east receive less than 20 inches annual rainfall. Two-fifths of Spain is cultivated, while one-half comprises meadows, pastures, bush and forests. Wheat is grown on 11,500,000 acres, barley 4,200,000 acres, rye 1,650,000 acres and maize 1,150,000 acres. Rice is grown on a small area near Valencia. Potatoes and sugar beet are produced in the north, while in the south are found the only sugar cane area and the only date palm plantation in Europe.

The olive tree is of great importance : half the world's olive oil is normally produced in Spain. Vines cover 3,500,000 acres, but produce less heavily than in France. Nevertheless world famous wines, grapes and raisins are produced. Citrus fruits are also important and are grown on a strip whose inland limit is determined by winter frosts.

The possibilities for olive trees and the cork oak in Western Australia were suggested in view of climatic similarities with Spain.

On 2nd August the Branch was given a very interesting talk on New Guinea by Mr. B. A. O'Connor, a Western Australian graduate who has been engaged on entomological problems in the Mandated Territory for the past six years. In New Guinea copra is by far the major agricultural product, but the agricultural methods on the coconut plantations are rather primitive and hardly likely to improve with the present depressed prices. The alluvial gold dredging on the Bulolo River at present provides a handsome revenue for the Territory through a 5 per cent. excise. Many interesting sidelights on the mentality and beliefs of the natives were given by Mr. O'Connor and the talk concluded with a brief discussion of pidgin English.

Current Notes and News

Agricultural Sciences Club, S.A.

The twelfth annual general meeting was held on 24th April, 1940. Mr. D. C. Swan was elected President and Mr. A. C. Oertal re-elected as Secretary.

Mr. J. S. Hosking, who returned recently from America, discussed the general standards of education in America, the rôle of the university in American life and the student attendance. An outline of the organisation of the University of California was given as a specific example, stressing the close relationship between the college, the agricultural experiment stations and the Farm Extension Service. A summary of the active research projects in the field of soil science at the University of California followed, with particular reference to physico-chemical problems and mineralogical investigations. Finally the general work on clay minerals of the soil and its relation to problems in practical agriculture were discussed.

Dr. H. C. Trumble, who also recently returned from a visit to America, dealt with the nature and scope of agronomy, indicating that in U.S.A. the term covered the use of the land in general rather than the original definition of " the growing of bigger and better crops ". Specialisation has narrowed the interest of the individual but progress is achieved by organised cooperation of specialists. The organisation of the U.S. Department of Agriculture and its relations with State activities were explained. A series of lantern slides was shown, illustrating in particular the work of the Soil Conservation Service and Division of Range Research of the Forest Service.

Two papers were read at the meeting held on 23rd May, 1940. Mr. T. J. Marshall, speaking of " Sieves and Sieving ", pointed out that the present method of tabulation of mechanical analyses of sandy soils gives inadequate information. It could be improved by adding a figure for average particle size, such as the mode, which would also act as a useful single value in comparing different sandy types. An account was given of progress of work by various soil workers at the Waite Institute on the standardisation of sieving procedures in mechanical analyses. Specification of sieve apertures by detailed microscopic measurements improved the consistency of data on sand fractions in mechanical analyses of soils. A mechanical shaker for sieves, to eliminate discrepancies in hand sieving practice, had been tried out with satisfactory results when the details of its use had been standardised.

Mr. J. C. M. Fornachon dealt with " Some recent developments in production of improved yeasts ". Strains of yeasts suited to special circumstances may be obtained by selection, or in some cases by habituation. The characters acquired by yeasts as a result of habituation appear to be transmitted as a modification of the cytoplasm, since such characters show some degree of permanence during vegetative multiplication but are lost immediately on sporulation. Yeasts of the genus Saccharomyces are normally diploid and often heterozygous in respect to some characters. Genetic segregation and the occasional appearance of haploid strains offer an explanation of certain degenerations and variations which sometimes occur in industrial and culture yeasts. Winge's hybridisation work appears to offer commercial possibilities since yeasts can be multiplied vegetatively indefinitely. Winge's hybrids exhibit certain analogies with hybrids in higher plants, including dominant and recessive characters, hybrid vigour, segregation in F_2 and interspecific hybrid sterility.

Doctorates Conferred.

The conferring of the Ph.D. degree in June last on Mr. F. T. Bowman, Fruit Research Officer, N.S.W. Department of Agriculture, by Michigan State College, marks the first American award of the doctorate to an Australian in horticulture. The degree was conferred *in absentia* for a thesis on " the influence of early times of fruit removal on the

growth, composition and blossom bud formation in sugar prune trees". Dr. Bowman gained the Hawkesbury Diploma of Agriculture in 1924 and graduated B.Sc.Agr. from Sydney University in 1928. As Ben Fuller Travelling Scholar, he studied horticulture at the University of California, where he was admitted to the M.Sc. degree in 1936, and later at Michigan State College. He travelled extensively in U.S.A. and England and on return to N.S.W. resumed his position of Fruit Research Officer.

Mr. N. H. Parberry was admitted in June last to the degree of D.Sc.Agr. at Sydney University. His thesis was entitled " the basaltic and associated soils of the Tweed River and Richmond River districts and the Dorrigo, Comboyne and Robertson Plateaux ". Dr. Parberry graduated B.Sc.Agr. with honours in 1927, and two years later was sent by the N.S.W. Department of Agriculture to make a special study of soil science at Rothamsted and New Jersey Experiment Stations, where he spent two years. On return to N.S.W. in 1931 he specialised in soil researches. He gained his M.Sc.Agr. at Sydney University in 1935.

The Improvement of Primary Production.

How agricultural and veterinary sciences can improve primary production was the subject of discussion at a joint meeting of the N.S.W. Branch of the Institute and the Australian Veterinary Association, held in the Veterinary School, Sydney University, on August 12th.

Speaking on the Influence of Feed on Animal Health, Mr. Max Henry, Chief Veterinary Surgeon, stressed at the outset the financial drag of stock diseases on stock-owners, not in mortality alone, but also in the ill-health that prevents the full marketing possibilities of the stock. Malnutrition and starvation, which are the most obvious losses from improper feeding, are conditions that are not sufficiently recognised. They constitute a loss that is much more extensive than is usually brought to mind by the term " drought condition ", and on the coast, and still more on the tablelands, constitute in late winter and early spring a much too usual state of affairs. The grazing of crops and the feeding of conserved fodder at such time would have a wide influence on animal health. Pasture improvement in its widest sense is considered desirable everywhere for maintaining stock in a healthful state, although there is a danger of excess protein, which may give rise to faulty reproduction and skin sensitisation in stock. A second influence of feeding on health appears in the disorders grouped as mineral deficiencies and imbalance. Calcium and phosphorus deficiencies are of long standing, and Hypocalcæmia and Hypomagnesæmia are now being experienced. Lastly, for parasitic infestation, e.g. worms in sheep, experimental results, demonstrated thirty years ago, have developed into the practice of supplementary feeding for the definite purpose of limiting loss from this cause.

Mr. A. D. Gill, Officer-in-Charge, McMaster Animal Health Laboratory, stressed the idea that health was a positive condition, not the negative one of not having certain recognised diseases. He dealt also with expansive possibilities in respect of consumption of animal produce, and instanced the use of lactation curves as a sound means of study to improve the average butter fat production (150 lb. per annum) of Australian dairy cows to compare with that of New Zealand (240 lb.) and Denmark (300 lb.).

Mr. Wenholz, Director of Plant Breeding, spoke on some phases of crop farming in relation to stock raising. He stated that even before the outbreak of the present war, the demand for wheat, and more especially for Australian wheat, was declining in European markets. Moreover, specialised wheat growing in Australia had led to serious loss of soil fertility, problems in soil erosion, rapidly growing difficulties in weed control, and an increase in soil-borne wheat diseases, and the time had definitely come in Australian wheat farming economy for greater diversification. In this, pasture plants must play a very important part. Oats, too, were important, and in this crop there were high yielding early

maturing varieties available to wheat growers in every district of the State. The protein content of N.S.W. oats varied from 8 to 16 per cent. according to variety and district.

Mr. A. W. S. Moodie, Senior Agrostologist, stated that the stockraising industries of N.S.W. suffered from several major disabilities due almost entirely to pasture deficiencies. These disabilities included :

(*a*) Uneven volume of production from season to season and from year to year.

(*b*) The incidence of diseases and losses due to mineral deficiencies, malnutrition, and actual starvation.

(*c*) Slow maturity of animals raised on natural pastures.

(*d*) Low acre carrying capacity.

Pasture improvement and fodder conservation could overcome most of these handicaps, increase production, and ultimately provide for a greater rural population.

Following a general discussion, the meeting agreed that the N.S.W. Branches of the A.I.A.S. and the A.V.A. should appoint a joint committee to consider ways and means of improving existing extension services.

Book Review

THE CHEMISTRY AND TOXICOLOGY OF INSECTICIDES, by H. H. SHEPHARD.

(*Pp.* 383, *with* 97 *tables and* 40 *line figures. Burgess Publishing Company, Minneapolis, Minnesota,* 1939. 4 *dollars.*)

In his foreword the author, who is Assistant Professor of Entomology and Economic Zoology at the University of Minnesota, describes the purpose of this volume as " to present within the limits of a book of convenient size the important facts and theories relative to insecticides, including not only chemical, physical and toxicological aspects, but also information regarding the history and commerce pertaining to this field ". He has succeeded admirably. The book, the first of its kind, is excellent.

Insecticides are dealt with in the broad classes of stomach poisons, contact poisons and fumigants ; while attractants, repellents and inert ingredients of mixtures are at least adequately discussed.

Emulsification, wetting and spreading and adhesion, the chemistry of soaps and oils receive full consideration.

The history of insecticides, principles of insecticide toxicology and quantitative toxicology (including statistical methods employed) form three early chapters. After dealing with stomach poisons, the author presents a table which he has prepared from recent publications and which shows figures arrived at for median lethal doses of some twenty insecticides. Nineteen species of test insects, most of them Lepidopterous larvæ, are included.

The literature dealing with insecticide residues and the methods by which the problem has been attacked are reviewed in detail, commencing with the work of the British Royal Commission on Arsenical Poisoning and the " arsenic tolerance " which later appeared in public health legislation, and concluding with the most modern methods of residue removal.

The short section on dips and dressings is below the standard of other chapters.

References are given at the end of each section and the total number is enormous. No entomological laboratory or chemist working with insecticides can afford to be without this book.

R. N. McCulloch.

Personal Notes

Dr. H. J. Hynes has been appointed Chief Biologist in the N.S.W. Department of Agriculture ; Dr. C. J. Magee has been appointed Senior Biologist.

Dr. E. J. Underwood, of W.A., has been appointed to the Nutrition Committee of the National Health and Medical Research Council of Australia.

Mr. H. A. J. Pittman has joined the staff of the Victorian Department of Agriculture and is engaged on plant pathological problems at the Plant Research Laboratory, Burnley.

Mr. J. M. Allen, a former member of the C.S.I.R., has resigned his position as Tobacco Research Officer to the N.Z. Government, and has been appointed Tobacco Adviser in the Department of Agriculture, W.A.

Mr. G. D. Hubble has been seconded from the Waite Institute to the Queensland Department of Agriculture for two years to conduct soil survey work.

Mr. E. G. Pont has resigned from the N.S.W. Department of Agriculture and has taken up a position as Research Officer in Dairy Bacteriology with the C.S.I.R. He is located at the State Research Farm, Werribee, Vic.

The August meeting of the Royal Society of N.S.W. was devoted to a symposium on " Potassium ", the speakers being Mr. G. de V. Davis, Mr. D. P. Mellor, Dr. N. H. Parbery and Dr. R. N. Robertson. A film on the mining and manufacture of potash in Europe was also shown by Mr. Davis.

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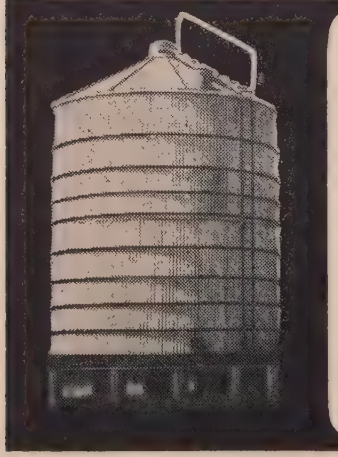

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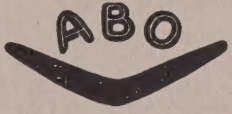

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